TOWN OF BRECKENRIDGE
OPEN SPACE ADVISORY COMMISSION
Monday, February 16, 2015
Lower Level Conference Room
Breckenridge Town Hall
150 Ski Hill Road

5:30 Call to Order, Roll Call

5:35 Discussion/approval of Minutes – January 19, 2014 ***5***

5:45 Discussion/approval of Agenda

5:50 Public Comment (Non-Agenda Items)

6:00 Staff Summary
- Breckenridge Ski Area 2015 Summer Work Proposal Update ***9***
- Pump Track Relocation Update
- McCain Master Plan Update

6:15 Open Space
- 2014 Cucumber Gulch Preserve Research ***10, 86***
- Breckenridge Ski Resort On-Mountain Amenities Draft Environmental Impact Statement ***145***
- Pro Forma Revisions ***151***

8:00 Adjourn

For further information, please contact the Open Space and Trails Program at 970-547-3155 (Scott) or 970-453-3371 (Chris).

Memorandum

To:	Breckenridge Open Space Advisory Commission
From:	Open Space Staff
Re:	February 16, 2015 Meeting

Staff Summary

Breckenridge Ski Area 2015 Summer Work Proposal Update

Attached to this packet is a copy of the Town's letter submitted to the U.S. Forest Service (USFS) regarding Breckenridge Ski Resort's (BSR's) 2015 summer work proposal. As discussed by BOSAC in January, BSR's proposal focused on grading a portion of the Monte Cristo ski run and adding snowmaking infrastructure to serve the lower portions of the Peak 6 ski runs. The attached comment letter was sent by the January 30th submittal deadline.

Pump Track Relocation Update

The relocation of the Town pump track to the Stillson Placer is scheduled to occur this spring, in time for a July 1st opening. Staff recently released a request for bid to several potential pump track design and construction companies with a bid submittal deadline of March 13th. Staff will keep BOSAC informed of any progress on this project.

McCain Master Plan Update

Staff continues to work with a consultant to draft a master plan for the 120-acre McCain property. Town Council is scheduled to review several concepts at their 3/10 meeting and provide general direction to staff and the consultant for moving ahead. Currently, all options include the preservation of the restored Blue River corridor as open space. Various other programming options are also shown (e.g. municipal water plant, ski area parking, solar garden addition, trails, snow storage, etc.) and Council intends to provide policy direction to narrow the focus of the uses on the property. Following that, the consultant will draft another design to be presented to BOSAC at its 4/20 meeting and then Town Council on 4/28. Staff will update BOSAC on this planning process as needed. Please feel free to attend the 3/10 Town Council discussion on the site programming if you are interested.

Open Space

2014 Cucumber Gulch Preserve Research

Attached are two reports from the Town's consultants for Cucumber Gulch Preserve. The first document, submitted by Dr. Christy Carello of Emerald Planet, outlines the research pertaining to wildlife, habitat values and trail use in Cucumber Gulch. The second document, submitted by Mark Beardsley and Jessica Doran of EcoMetrics and Brad Johnson of Johnson Environmental Consulting (JEC), summarizes the results of the wetland monitoring program, as required by the U.S. Army Corps of Engineers.

The following are the summary points of the two reports:

Dr. Carello:

- In general, most management indicators in Cucumber Gulch are trending in a positive direction based on 2014 research.
- In particular, sightings of mammalian species increased this year, most notably deer, moose and beaver. A beaver den survey indicated increased

beaver activity Preserve-wide, and in the restored upper Cucumber Gulch in particular.

- Two boreal toads were sighted during 2014. These sightings were the first since 2005.
- Although improving based on fortified seasonal closures and the presence of docents, there are still management challenges from off trail travel, trail use during closures, and dogs. Additional signage and docent scheduling are recommended.
- Avian abundance, species richness and diversity declined in mixed conifer and shrubland habitat in 2014. Additional monitoring in 2015 and beyond should help clarify whether this is an aberration or a concerning trend.
- Vegetation sampling indicated the growing presence of non-native and invasive plant species in the interior of the Preserve. Additional weed eradication efforts are recommended.
- Additional research, docent presence, public education, signage, weed eradication and management efforts are the primary recommendations for 2015.

EcoMetrics/JEC:

- Water source, distribution and chemical environment variables are generally improving, particularly in upper Cucumber Gulch, the site of the recent wetland and stream restoration efforts. The resultant improvement and expansion of the wetlands indicate that the restoration efforts have been successful.
- The presence of an active beaver population in upper Cucumber Gulch is especially promising.
- Additional monitoring and maintenance of the lateral spreader channel that diverts water from Boreas Creek below the 60" culvert will ensure sediment does not block this channel and prevent water flow to the northern portion of the wetland area.
- Dredging of the spreader pond in 2015 to remove thirty-three cubic yards of deposited sediment is recommended.
- Continued weed eradication efforts are strongly encouraged.
- Additional (and timelier) data is needed to determine whether algal blooms in upper Cucumber Gulch are related to elevated nutrient levels from external sources.

Staff requests BOSAC review the attached reports and answer the following questions:

1. ***Does BOSAC have any questions regarding the content of the two Cucumber Gulch Preserve annual reports?***
2. ***Does BOSAC have any recommendations for improving the management and monitoring of Cucumber Gulch Preserve?***
3. ***Specifically, what is BOSAC's direction regarding the recommendations to increase the docent presence, add water quality research elements (i.e. chemical measurements to get at the algal blooms), and dredge the spreader pond in 2015?***

Breckenridge Ski Resort On-Mountain Amenities Draft Environmental Impact Statement

As previously discussed by BOSAC, Breckenridge Ski Resort (BSR) has proposed the addition of multiple on-mountain amenities (i.e. zip lines, canopy tours, trails, etc.) to be considered by the U.S. Forest Service under their NEPA process. Following an initial scoping period in 2014, the USFS reviewed public input and then recently released the Draft Environmental Impact Statement (DEIS). The DEIS outlines two action alternatives (in addition to the requisite "no action" alternative), evaluates their potential impacts to the National Forest, and seeks public input on the proposed alternatives.

Following the current comment period on the DEIS, USFS Forest Supervisor Scott Fitzwilliams will consider the public comments, issue a decision notice, and then engage in a required appeal period for the decision. Now is the best and most productive time to provide feedback on the proposed facility expansion proposed by BSR.

The full copy of the DEIS can be found here. The executive summary at the beginning of the document succinctly outlines the primary DEIS analysis points.

Also attached is a draft response letter from the Town to the USFS for BOSAC to consider. The draft content is based on the Town's previous comment letter and staff analysis of the DEIS document. The draft letter generally supports Alternative 3, which is a slightly toned-down version of BSR's original proposal (Alternative 2), and reflects changes based on previous public input including the Town's original scoping letter.

Staff requests BOSAC review the DEIS and draft comment letter and respond to the following questions:

1. ***Does BOSAC have any questions regarding the content of the DEIS?***
2. ***Does BOSAC have any questions regarding the content of the draft Town comment letter?***
3. ***What changes would BOSAC recommend to improve the draft comment letter for Town Council consideration on 2/24?***

Pro Forma Revisions

Attached, please find a memo sent to Town Council for its 2/10 meeting and a revised open space pro forma, reflecting BOSAC and Town Council's priorities for the open space program. Town Council approved the attached revised pro forma, which allocates additional funds as outlined in the memo.

Please review the attached pro forma and memo, and come prepared with any comments or questions you have.

Roll Call
Jeff Cospolich called the January 19, 2015 BOSAC meeting to order at 5:30 pm. Other BOSAC members present included Elisabeth Lawrence, Jeffrey Bergeron, Jeff Carlson, Craig Campbell and Elizabeth Miller. Chris Tennal was absent. Staff members present were Peter Grosshuesch, Scott Reid, Mark Truckey and Chris Kulick. Todd Rankin from the Summit County Open Space Commission and Jeff Zimmerman from the Breckenridge Ski Resort were also in attendance.

Approval of Minutes
The minutes were approved as presented.

Approval of Agenda
A Pro Forma update was added as an agenda item.

Public Comments
There were no public comments.

Staff Summary

Breckenridge Ski Resort On-Mountain Activities NEPA Decision Update
As discussed by BOSAC last February, the Breckenridge Ski Resort (BSR) has proposed new on-mountain infrastructure which is currently being analyzed by the U.S. Forest Service under a NEPA review. The proposal, which includes zip lines, canopy tours, new mountain bike trails, and other associated amenities would be consistent with the *Ski Area Recreational Opportunity Enhancement Act* of 2011 by focusing increased summer and winter visitation on the ski area, where ski lifts, restaurants and other on-mountain infrastructure exists. BOSAC and Town Council developed and submitted the attached comment letter regarding BSR's original proposal. The USFS released the draft EIS (Environmental Impact Statement) on January 16th and includes three alternatives to be considered for public comment (including one no action alternative).

Staff provided BOSAC with an electronic version of the document to review prior to the upcoming February 16th meeting. Town Council will then review the EIS and BOSAC's recommendations on February 24th, in order to comment by the USFS's March 2nd deadline.

Mr. Zimmerman – The EIS report is available online. The two action alternatives include the ski area proposal (Alternative 2) and a USFS-generated alternative (Alternative 3). I look forward to discussing the specifics with BOSAC in February.

Mr. Campbell – Please send a reminder to BOSAC regarding the opportunities for public input (2/24 at approximately 4:00 pm Town Council discussion and 2/24 5:00-7:00 pm at the Mountain Thunder Lodge for a public open house.)

Kingfisher Claims Update
The Town closed on a partial interest in the 18.89-acre American Gulch-based Kingfisher Claims (43.75% interest). As previously discussed, the Town and Summit County now split 87.5% ownership in the parcel, which includes a portion of the Wapiti town site. The Town's purchase from Summit County closed on January 9th.

Open Space

Breckenridge Ski Resort 2015 Summer Work Proposal

Annually, the Breckenridge Ski Resort (BSR) submits a summer work proposal to the U.S. Forest Service to address on-mountain work. Unlike the on-mountain activities EIS proposal above, the summer work proposal does not require a large-scale NEPA review (EA or EIS), but rather undergoes an expedited "categorical exclusion" (CE) analysis. The attached scoping notice seeks public input for BSR-related work, including grading a portion of the Monte Cristo trail and installing a snowmaking pipe extension for the lower Peak 6 runs.

Mr. Bergeron – How will the snow making pipes cross Cucumber Creek? (Mr. Zimmerman – They will be bored under one branch of Cucumber Creek and above ground for the second branch. Topographically, it caused the least amount of disturbance.)

Mr. Bergeron – How will the additional snowmaking impact the Cucumber Gulch watershed? (Staff – There will be minimal impacts in terms of additional water in the creek. Seasonal variation in snowfall is much greater than the potential amount of additional snow from the proposed project.)

Mr. Bergeron – However, is there a difference between the melt off of manmade and natural snow? (Mr. Zimmerman – Manmade snow does not increase the immediate intensity of runoff but does increase the duration.) (Staff – Snow pack does not tend to produce big runoff surges on its own. Large rain events during peak run-off are generally responsible for large surges.)

Mr. Bergeron – What about noxious weeds? Recently disturbed areas on the ski area tend to have weed infestations. (Mr. Zimmerman – The USFS monitors our revegetation and weed eradication efforts. We have the resources and staff to address weed eradication and the USFS oversees that work annually.)

Mr. Campbell – How much site disturbance will this project cause? (Mr. Zimmerman – The entire area where the snowmaking pipe will go was disturbed as part of the Peak 6 expansion two years ago; that is the reason we have proposed the project now. We want to complete the trench before the revegetation comes back on the ski runs. As part of our permit, the USFS monitors our sediment control efforts as well.)

Mr. Carlson – Does the proposed boring excavation under Cucumber Creek include a sleeve or PVC pipe to contain the snowmaking lines? (Mr. Zimmerman – Yes, the air and water pipes will be included within a plastic conduit where we bore.)

Ms. Miller – Why was the snowmaking infrastructure not proposed as part of the original Peak 6 proposal and NEPA analysis? (Mr. Zimmerman – Following our first season, we realized that we needed better coverage for the Zendo Chair offload area and the lower portions of the runs towards the bottom of Kensho Chair. Our goal is to make approximately one foot of snow on these areas, so we can open up all of the upper terrain earlier.)

Mr. Reid – I am joining USFS and Summit County staff on 1/21 for a site visit to the proposed construction areas. BOSAC members are certainly welcome to join us.

BOSAC directed staff to attend the site visit and draft a comment letter to be submitted to the USFS prior to the deadline.

Blue River Restoration Background Discussion
As requested during the December meeting, staff provided BOSAC with an overview of Blue River restoration efforts in town during the past 30 years.

Staff presented BOSAC a PowerPoint slideshow outlining previous Blue River restoration efforts. This was the same presentation that Town Council received in July 2013 from Peggy Bailey of Tetra Tech. The goal of this presentation was to educate BOSAC on prior and current restoration projects along the Blue River. The McCain property is the next reach to be restored in 2015 and 2016 with funding coming from the open space and general funds. Also, the draft McCain property master plan will likely be presented to BOSAC at its April 20th meeting. This master plan will provide the broader context for the McCain parcel, overall site programming, and public interaction with the river corridor.

Ms. Miller – Is there any way to reallocate funds from the Wellington Oro Treatment Facility to a more effective mitigation strategy for all of French Gulch? (Staff – We are in the middle of a five year review of the Wellington Oro facility with the EPA so we will have a better understanding of the project's success once that review is completed.)

Ms. Lawrence – Council is still reviewing options for the Block 11 stretch of the river, including the Coyne Valley Bridge. We will look at the option more in-depth at the May 12th Council retreat.

Mr. Campbell – What are the priorities for sections of the river to restore? I know McCain is important but what about the stretch behind the Parkway Center? (Staff – The Parkway would be a good candidate for future restoration, however, due to space constraints its somewhat dependant on a redevelopment of the site. The McCain parcel has fewer constraints; therefore it is closer to being shovel-ready.)

Mr. Carlson – Is there any water quality testing going on at the confluence of French Creek and the Blue River? (Staff – There are many testing sites along both French Creek and the Blue River, including at that confluence. Overall, the water quality gets much better the further downstream it is from French Creek.

Mr. Cospolich – How do you decide when and where to use crusher fine as opposed to single track for a trail design. (Staff – We generally try to avoid using crusher fine due to its installation and upkeep costs but it ultimately comes down the volume of use.)

BOSAC thanked staff for the restoration primer and anticipates being involved in the future river restoration efforts on McCain and elsewhere.

2015 Open Space Work Plan
Staff presented the draft 2015 open space work plan. This document, updated annually, outlines the program goals for the year. Please note that there are two pages: ongoing duties and 2015 work plan. Staff reviewed both categories with BOSAC and sought feedback.

Mr. Cospolich – How do you audit the license agreements? (Staff – Since the license agreements are ongoing and most have existed for many years we feel we have a pretty good understanding of how the operations are functioning. In general, we tend to be much more involved in and watchful over the 20 or so special events we permit each year.)

Mr. Cospolich – How is the GOCO grant proposal for the river plan different from the existing plan prepared by DTJ? (Staff – The grant proposal will distill the scope to the three highest priority projects from the DTJ plan and potentially bring them to a 70% design level.)

Mr. Bergeron – I noticed the Hoosier Pass trailhead is not being plowed this year; who has plowed the trailhead in the past? (Staff – CDOT.)

Ms. Miller – When will it be decided on which USFS projects will be taken on this year? (Staff – Most likely, we will reach out to partner with the Friends of the Dillon Ranger District on a Baker's Tank Trail project to start.)

BOSAC approved the 2015 work plan as presented.

Pro Forma Update
Mr. Truckey – We have learned more about the restrictions and penalties for early payout of the B&B bond and are now reassessing our options. We may not pay the B&B debt off early at all, or switch bond holders to benefit the program. We will let BOSAC know of any changes, but for now it looks like the B&B debt service will not be paid off early.

Council Update
Ms. Lawrence updated the BOSAC on the affordable housing density transfer from Prospector Park to Maggie Point and the amended smoking ordinance which now prohibits smoking on Town open space parcels, parks and the recpath.

Executive Session
Ms. Miller – Motioned to move into Executive Session at 7:26 pm to discuss property acquisition negotiations.

Mr. Bergeron – seconded the motion.

Mr. Bergeron – Made a motion to come out of Executive Session at 8:37 pm. Mr. Cospolich seconded the motion.

Next Meeting
The next regularly scheduled meeting is on Monday, February 16, 2015, at the Breckenridge Town Hall, 150 Ski Hill Road.

Mr. Bergeron motioned to adjourn the meeting, which was seconded by Mr. Cospolich.

The meeting was adjourned at 8:11 p.m.

_____
Jeff Cospolich, Chair

TOWN OF
BRECKENRIDGE

January 30, 2015

Scott G. Fitzwilliams, Forest Supervisor
c/o Shelly Grail Braudis
U.S. Forest Service
120 Midland Avenue, Suite 140
Glenwood Springs, CO 81601

Dear Mr. Fitzwilliams:

Thank you for the opportunity to comment on proposed 2015 projects on the Breckenridge Ski Resort (BSR). In your letter, dated January 5, 2015, the project scope was outlined to generally include grading and tree clearing along a portion of Monte Cristo ski trail, and installation of snowmaking infrastructure to serve the lower runs of the Peak 6 expansion area. The Town of Breckenridge appreciates the opportunity to comment on BSR's proposal. We understand that this decision is being considered as a categorical exclusion. We also appreciate the USFS and BSR staff members hosting an informative site visit for Town of Breckenridge and Summit County staff members on January 21st.

In general, the Town of Breckenridge supports BSR's goals to widen and smooth the Monte Cristo ski trail, which receives significantly more skier traffic with last year's Peak 6 expansion. The site visit with USFS and BSR staff revealed the close proximity of the wetlands to the proposed grading site and tree removal areas. We recommend the use of best management practices in this area to prevent sediment transport into the adjacent wetlands and minimize wetland disturbance. Specifically, the recommended over-snow removal of the trees located within the wetlands seems prudent.

Regarding the proposed Peak 6 snowmaking infrastructure, we agree with BSR's goal to minimize wetland impacts to Cucumber Creek by boring beneath one channel and crossing above the other channel. We also agree that trenching in the ski runs is appropriate for the remainder of the snowmaking pipes. Generally speaking, our primary concern is that the revegetation efforts for both the snowmaking trench and the recently-cut ski runs are successful. We encourage BSR and the USFS to cooperatively and effectively ensure that native vegetation thrives. The use of imported compost and certified native seed that was successfully applied in Keystone should be used as a model for promoting vegetative growth here.

Thank you for the opportunity to comment on this proposal. If you have any questions or concerns regarding this letter, please contact Scott Reid at 970-547-3155 or ScottR@townofbreckenridge.com.

Sincerely,

John Warner, Mayor

Cucumber Gulch
Annual Conservation Monitoring Report 2014

Breckenridge, Colorado
February 2015

Prepared for the Town of Breckenridge, Colorado

By
Christy Carello, PhD
&
Elizabeth Kelso, MS

The Metropolitan State College of Denver, Denver CO
Emerald Planet, Fort Collins, CO

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Brief History of Cucumber Gulch

Cucumber Gulch, a fen wetland, contains a diversity of habitats including shrublands, lodgepole pine forests, mixed conifer forests and pronounced ecotones of mixed conifer and shrubland habitat. Conservation monitoring of vegetation, avian populations, beaver and ungulate populations and water quality have occurred since 2001. Recent anthropogenic threats to the integrity of Cucumber Gulch include private home construction, lodge development and ski area modifications along the perimeter. Both development and gondola construction resulted in a large area of tree removal in 2006. More tree removal occurred in 2008 along the perimeter of an enlarged retention pond below the Peak 8 base area. Lodge construction at the ski area base of Peak 8 and Peak 7 began in 2009 and continued throughout 2014. Changes in hydrology have resulted in drying of the wetland system near the top of the Gulch and sedimentation of ponds downstream. Hydrological restoration in 2012 and 2013 included diverting water at the main culvert entering Cucumber Gulch below Ski Hill Road at Peak 8 and the dredging of the reset pond near the beaver interpretive sign. This project is showing signs of success in terms of beaver activity and water flow.

Bird Populations in Cucumber Gulch

Avian abundance, species richness and diversity were significantly lower in mixed conifer and shrubland habitat in June of 2014. At this time the cause of this decline is unclear, continued monitoring will reveal whether this was a natural population fluctuation or an alarming trend. Unfortunately two common forest dwelling birds (American Robin and Dark-eyed Junco) were not observed in sampling locations in mixed conifer habitat in 2014.

Wildlife Populations in Cucumber Gulch

There was a slight change in the diversity of small mammals using the wetland in 2014 with fox sightings nearly doubling and pine martens seen far less frequently. Bear and coyote sightings held steady in 2014 and porcupines were photographed for the second year in a row. Deer sightings continued to steadily increase and were seen most frequently on the camera in the gondola cut. Moose captures of all age classes continued to increase and there is ample photographic evidence to confirm that moose cows are regularly using Cucumber Gulch to rear their young. Evidence of beaver activity throughout Cucumber in 2014 was documented and three active lodges were confirmed in November. In addition several regularly visited bank dens and several maintained dams throughout the wetland were documented. Beaver kits were observed at the newly active stump den located at the top of the gulch by the Peak 8 base. For the first time since 2005 boreal toads were sighted in Cucumber on two separate occasions. Neither toad was captured or photographed nonetheless it is encouraging to have the first confirmed toad sightings in the wetland in nearly ten years.

Human Presence in Cucumber Gulch

Humans continue to be photographed regularly on the off-trail cameras and were frequently observed off trail in 2014. People were most often seen off trail at the Peak 7

bridge underpass and in the gondola cut. Both of these areas are important movement corridors for animals to and from the upland. Additional signage at the trail intersection and the gondola cut could potentially discourage public access. Dogs are still regularly photographed off-trail and on-trail, the majority of which are off-leash and running loose. Improving the quality and visibility of the 'no dogs allowed' signage could greatly help curb this problem.

Human traffic on the portion of the recreation trail that crosses the gondola cut in Cucumber Gulch was monitored in both June and July of 2014. There were vast improvements in trail closure signage and barriers in 2014 and that, combined with the expanded trail docent program, had a significant effect in decreasing the average number of humans using the trails when they were closed. In June of 2014, there was a three-fold decrease in the average number of humans using the closed trails and a seven-fold decrease during the 4th of July weekend closure. The reduction in human disturbance during the annual closure was also reflected in an overall increase in the diversity of animals seen on and around the recreation trails during the closure. Human traffic continues to increase on the recreation trails and the average number of users per day has tripled since 2011. Trail use was not significantly different when comparing weekdays to weekends and hiking, mountain biking and trial running comprised 62%, 32%, and 6% respectively of the trail use activities. As mentioned earlier, the docent program was once again implemented in 2014 and the overall hours increased to span a total of ten days during the annual closure. The docent interacted with more than 200 visitors and informed the public about wetland safety, the importance of staying on the trails and the ecological factors, such as moose calving and bird nesting, which prompt wildlife managers to close the trails each year. An educational information board was on display at the trailhead that featured a wide variety of the species captured on the motion sensor cameras and which helped emphasize the importance of respecting the regulations in place which protect wildlife. The majority of visitors were supportive and seemed excited to hear about the wetland and its inhabitants. Very few visitors ignored the trail closure after interacting with the docent. Due to improved trail closure barricades there were very few visitors hiking out of Cucumber via the Ski Hill Rd trailhead and the overall number of people photographed on the recreation trail camera when the docent was present declined significantly. Several visitors reported being informed by hotel concierge and gondola operators that Cucumber Gulch was open all year round and that they are free to ignore the trail closure signs. We recommend that an additional role for the docent program in 2015 would include educational visits to the concierges and gondola operators with the intention of gaining their understanding and respect for the trail closures.

Vegetation in Cucumber Gulch

Vegetation sampling in macroplots was conducted in July of 2014, the first time prior to 2011. The results revealed a decrease in species diversity and evenness in shrubland habitat. This means that the relative abundance of one or a few species has increased. The most alarming finding was that more weeds were found in macroplots in 2014 than in any previous sampling period. Scentless chamomile was documented at B5, which is in the interior portion of the wetland complex, for the first time. Also the identification of

both scentless chamomile and yellow toadflax on the boundary hillside at Peak 8 and in the newly established macroplot could likely result in a major invasion if not addressed. Finally, the substantial patch of Canada thistle in the main wetland complex under the gondola could become problematic, especially if water is re-channeled or is less available in 2015. A new sampling plot was designated in the upper portion of Cucumber Gulch in order to document the expected improvements from the hydrological restoration in the area. Unfortunately, that plot was comprised of approximately 50% weedy species, including yellow toadflax and scentless chamomile.

Monitoring scorecard for Cucumber Gulch 2014.

Parameter	Score	Notes
Birds	Declined	Significant decrease in species in the mixed conifer and shrubland habitats.
Beavers	Improved	Although lodge numbers remain stable, evidence indicates increased activity especially at the top portion of the Gulch.
Toads	Improved	Two toads identified in 2014.
Mammals	Improved	Results likely a consequence of better trail closures in June and first week in July.
Trail use during closures	Improved	Results likely a consequence of better trail closures in June and first week in July.
Docent program	Improved	Favorable response from public.
Vegetation	Declined	Diversity and evenness of plant species in both habitats
Weeds	Declined	Invasive weedy species in interior of Gulch and along perimeter.

RECOMMENDATIONS FOR 2015

1. Continue seasonal trail closures with extensive signage from June 1 – July 6. This is a critical period for wildlife and newly emerging vegetation.

2. Increase the number of seasonal trail use signs posted throughout Cucumber from mid-May through the summer's end to include the gondola cut, the small unmarked trail just off the cut to the north of the recreation trail and the Peak 7 bridge underpass.

3. Expand the paid docent program to run Thursday – Sunday June 1 – August 31. Docent presence during closures has had a positive response from the public. During periods when the trails are open a docent moving throughout the gulch can help educate visitors and establish a helpful presence during the busy summer season while encouraging visitors to stay on trails and respect wildlife.

4. Invasive and non-native plants (weeds) should be identified and removed before going to seed, especially plants that are wetland adapted such as scentless chamomile, yellow toadflax, coast tarweed and Canada thistle.

5. Private home owners, landscape professionals working for the lodges at Peak 7 and 8, and ski area contractors/employees should be encouraged to plant only native plants in landscaping in order to prevent the introduction of foreign seeds to Cucumber Gulch.

6. Activities that may disrupt avian and mammalian breeding behavior should be minimized between May and August.

1.0 SONGBIRDS AND AQUATIC BIRDS

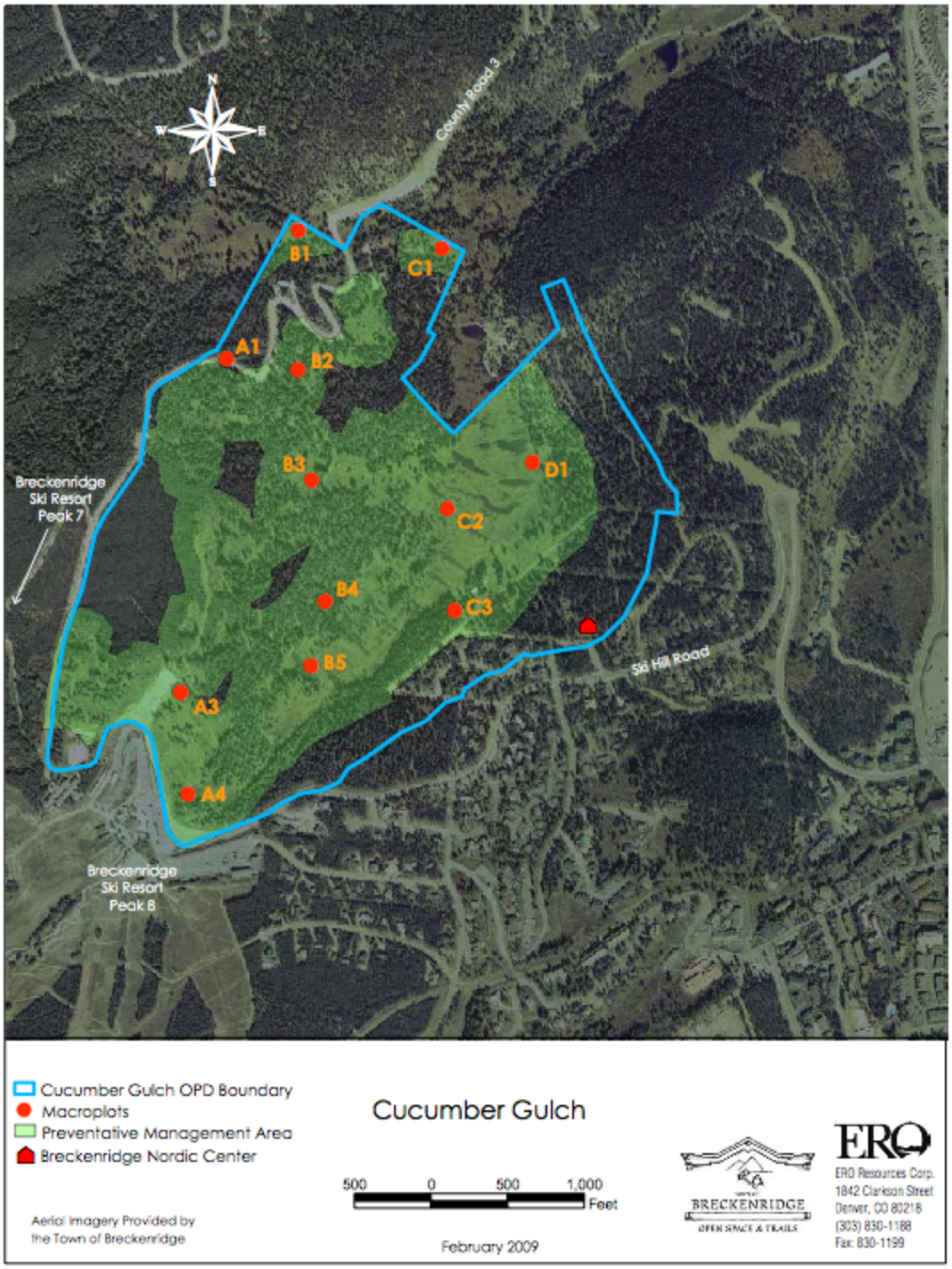
1.1 Background – terrestrial birds

Avian populations are important for monitoring the quality of the habitats within Cucumber Gulch. Bird populations are particularly sensitive to habitat disturbances and act as indicators of overall habitat quality. Birds select habitats based on the type of terrain (presence of lakes, ponds, streams and wetlands), vegetative features (grasslands, types and extent of forests, shrubby areas) and structural configuration of vegetation (density of leaves at various elevations above the ground or patchiness) (Smith and Smith 2001). Thus, it is necessary to maintain and protect those aspects of the landscape that are important to birds. Many of the avian species found in Cucumber Gulch require regular monitoring because they are exceptionally sensitive to habitat alteration.

1.2 Methods – terrestrial birds

Songbird population surveys were conducted in December, February, April, May, June, July, August and October from 2003-2011. From 2012 - 2014 avian monitoring was only conducted May – August by Dr. Christy Carello and an assistant.. Each survey was conducted at 13 macroplots (See Map on following page) that are a minimum of 200 meters apart from each other (A1, A3, A4, B1, B2, B3, B5, C1, C2, C3, D1, SW4, and GW1). A2 was eliminated in the later half of 2006 due to the Peak 7 development. A2 was the only macroplot in lodgepole pine habitat and was eliminated as a result of the Peak 7 development in April of 2006. A1, B2, C3 are found in mixed conifer habitat. A3, A4 and GW1 are in mixed conifer/shrubland habitat. The final 7 macroplots are located in the shrubland habitat (the macroplot habitat designations are slightly different from the vegetation surveys because the sampling areas are much larger). A point-count was used in which population numbers and species were recorded by visual or auditory identification for a total of 5 minutes within 50 meters from the center of the circular plot. At least 3 minutes were allowed to elapse prior to each sampling episode in order to minimize disturbance. Observations of individual birds were made during each survey in order to avoid counting the same bird more than once. The Simpson's Index was used to calculate both species diversity and evenness.

Single factor Analysis of Variance statistics and/or two sample T-test statistics were used to determine statistically significant differences between means on data from 2004-2012 (data prior to 2004 was collected by different personnel at SAIC and show different trends). Data from 2001-2003 is presented on graphs in previous reports, but is not included on graphs in this report. A standard probability value of 0.05 was used to determine significance, meaning that there is less than a 5% chance that the statistical differences are a result of error.



Map 1. Cucumber Gulch Map illustrating vegetation macroplots

1.3 Results and Discussion – terrestrial birds

Overall there was a statistically significant difference observed in the number of birds in the different habitats, where mixed conifer habitat had significantly fewer individual birds compared to the other two habitat types (Table 1.1; F=5.23, p=0.01). However, there were significantly more species and greater species diversity found in the ecotone (mixed conifer/shrub habitat). There was no difference in evenness between the three habitat types (Table 1.1; F=2.68, p=0.07).

Table 1.1. Overall comparison (2004-2013) of means (standard error) between habitat types. + and – symbols represent statistically different results. + means statistically greater than the other two and – means significantly less than the other two.

	Abundance	Richness	Diversity	Evenness
Mixed Conifer	**15.2 (4.74) -**	8.1 (1.76)	5.5 (1.05)	0.8 (0.07)
Shrubland	20.7 (4.90)	8.3 (2.38)	5.1 (0.99)	0.7 (0.10)
Mixed Conifer/Shrub	20.2 (3.61)	**9.6 (2.42) +**	**6.5 (1.07) +**	0.8 (0.08)

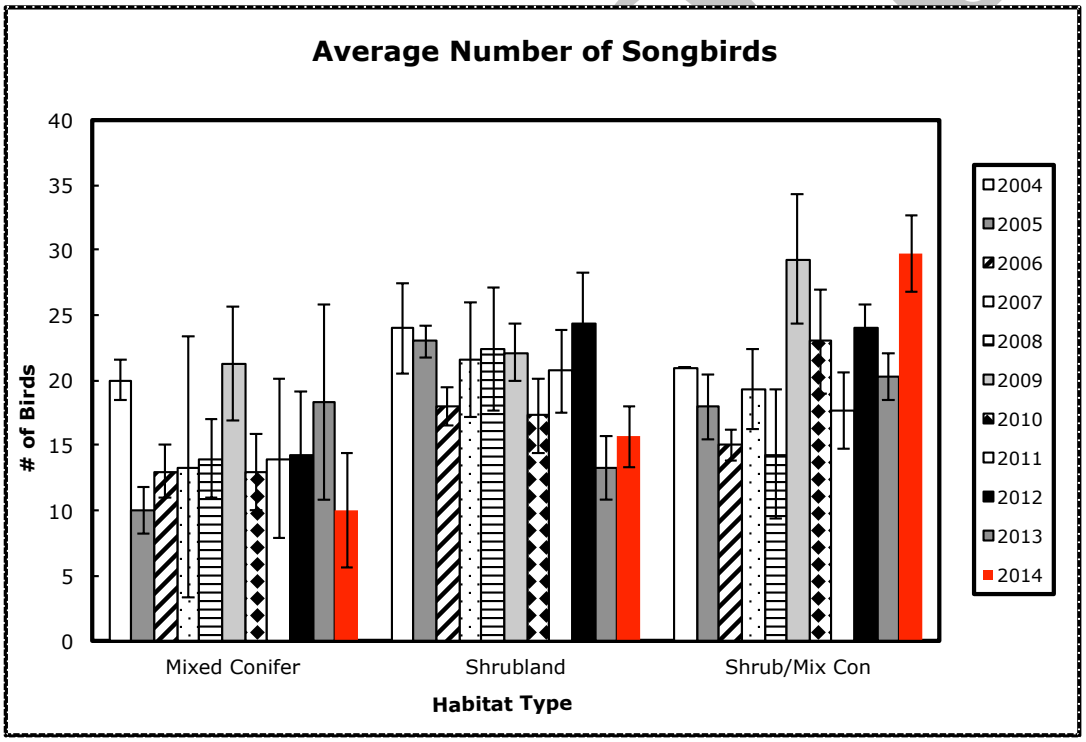


Figure 1.1 Comparison of the average number of birds seen or heard during two avian point counts in June 2004-2014 in Cucumber Gulch, Breckenridge, Colorado.

Fewer birds were observed in mixed conifer habitat in 2014. Although this decrease is not significant from the data in 2013 it is the lowest reported number since surveys began in 2003. When the results are compared to an average of number of birds from 2004-2013 the decrease is significant (Fig1.1; t=2.52, p=0.). There is no significant difference in the number of birds in shrubland habitat in 2014 from 2013, however numbers were the lowest reported in 2013 in this habitat type and remain low in 2014 (Fig1.1; t=2.52, p=0.). Significantly more birds were identified in the ecotone in 2014 when compared to 2013 (Fig1.1; t=2.52, p=0.). This result was similar to the number of birds reported in 2009 and this may reveal part of the natural fluctuation observed in avian populations.

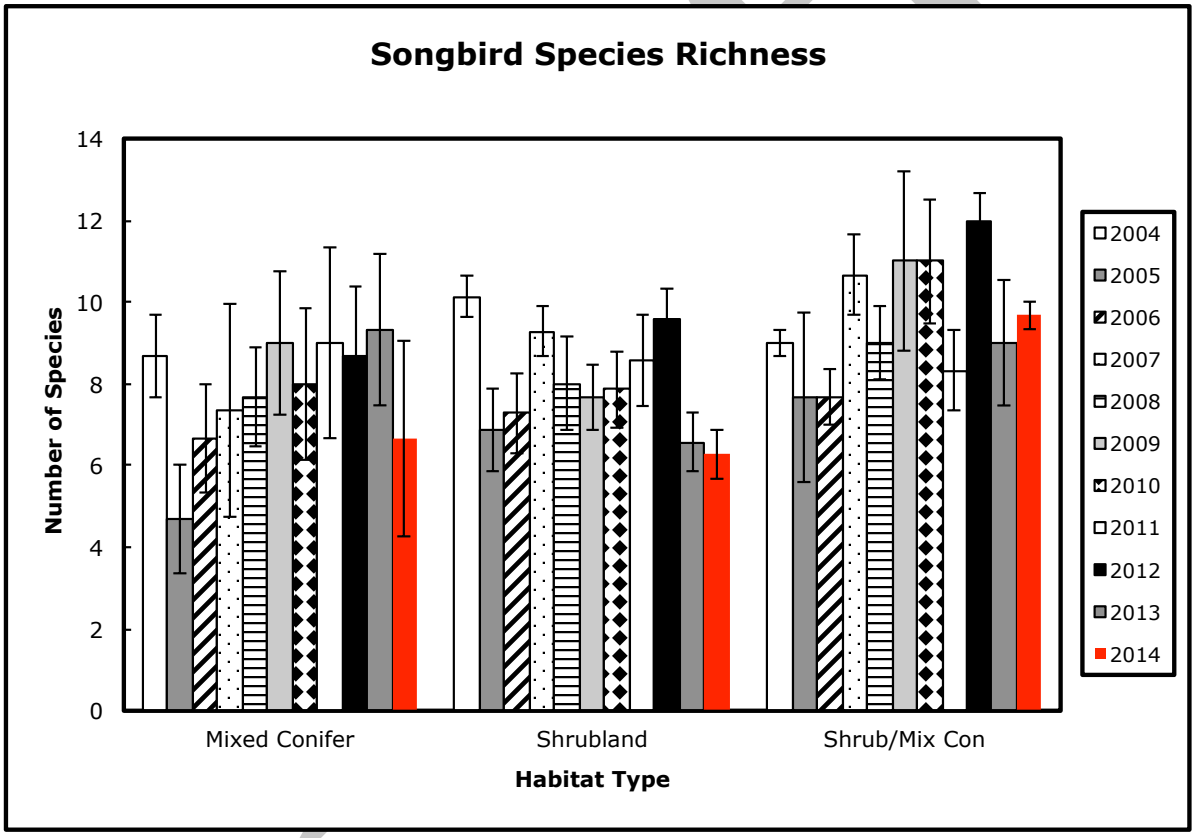


Figure 1.2 Comparison of the average avian species richness from two avian point counts in June 2004-2014 in Cucumber Gulch, Breckenridge, Colorado.

Species richness in mixed conifer habitat in 2014 was lower than results from the last eight years of observation. Although the results were not significantly different from 2013 (due to the large standard error), the results are significantly different from an average of combined years (Fig 1.2; t=2.02; p=). Two common species observed in previous years, the American Robin and the Dark-eyed Junco, were not observed in 2014 in this habitat type. In addition, two other frequently observed species were also not seen in this habitat in 2014: Brown Creeper and Red-breasted Nuthatch. Species richness remained low in shrubland habitat in 2014 and was consistent with the low values in 2013 (Fig 1.2; t=2.02; p=). Species richness in the ecotone was within the range of normal in 2014 (Fig 1.2; t=2.02; p=).

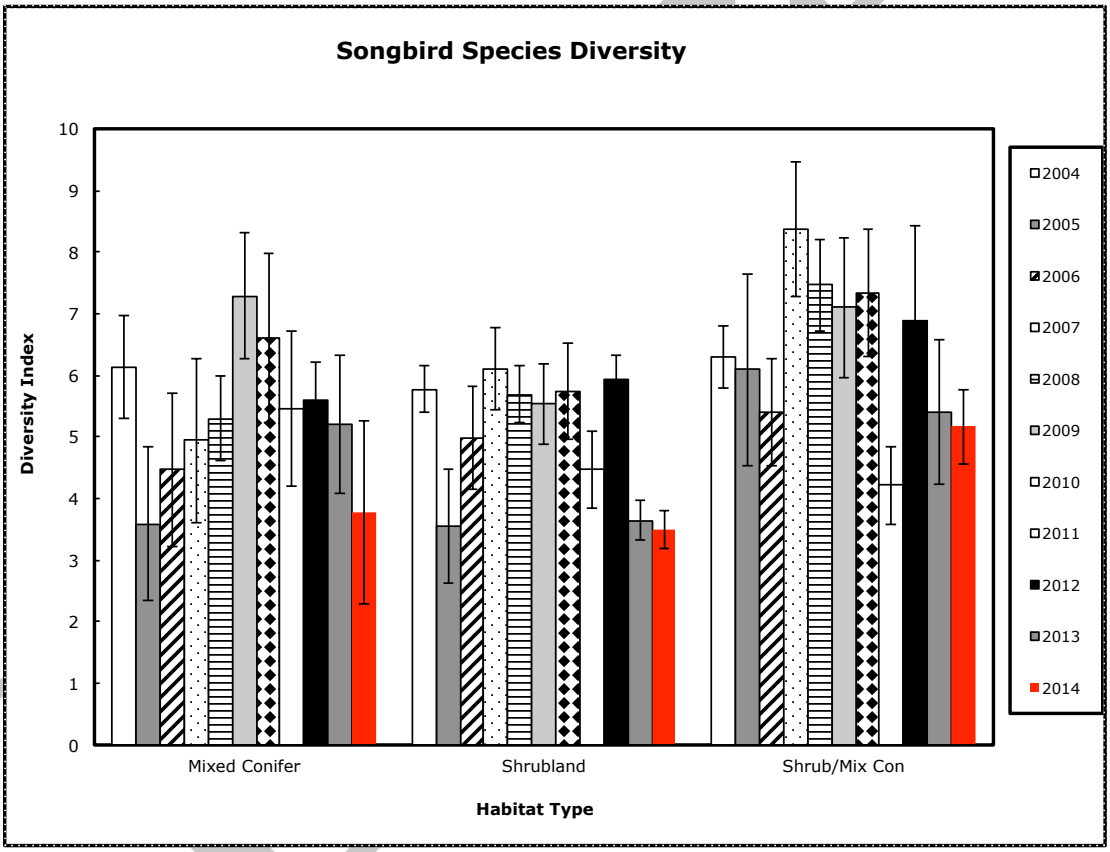


Figure 1.3 Comparison of the average avian species diversity from two avian point counts in June 2004-2014 in Cucumber Gulch, Breckenridge, Colorado.

Species diversity in mixed conifer habitat and shrubland revealed a similar pattern as species richness where results were lower in 2014 than results from the last 8 years of observation. Although the results were not significantly different from 2013 (due to the large standard error), the results are significantly different from an average of combined years (Fig 1.2; t=2.02; p=). Species diversity also remained low in shrubland habitat in 2014 and was consistent with the low values in 2013 (Fig 1.2; t=2.02; p=). Species diversity was the second lowest observed in Cucumber Gulch but not significantly different from 2013 (Fig 1.2; t=2.02; p=).

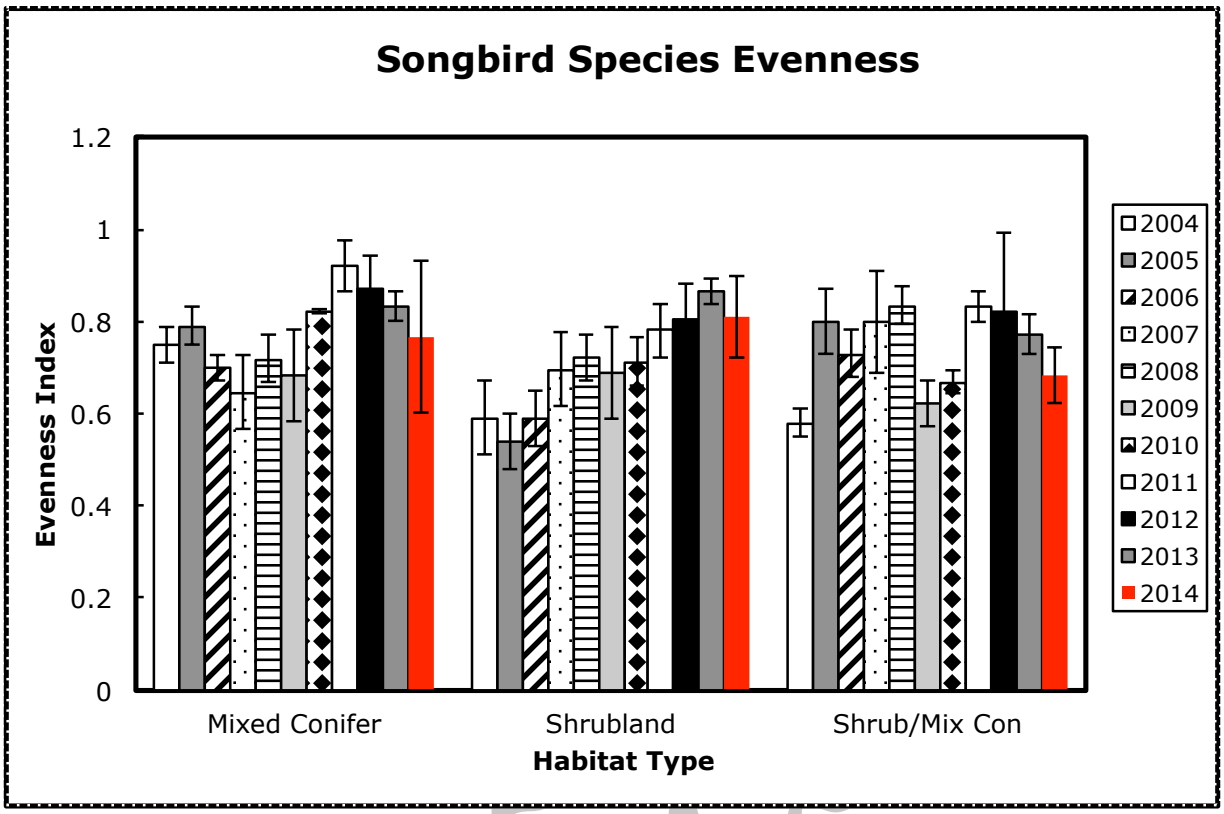


Figure 1.4 Comparison of the average avian species evenness from two avian point counts in June 2004-2014 in Cucumber Gulch, Breckenridge, Colorado.

There was no significant difference in eveness in avian species in Cucumber Gulch in any of the habitat types. Also evenness has been significantly variable between years in mixed conifer habitat and shrubland habitat (Fig 1.4; F=2.62, p=0.04; F=3.00, p=0.01). This result reveals that in general, the relative representation of each species in each habitat type is highly variable.

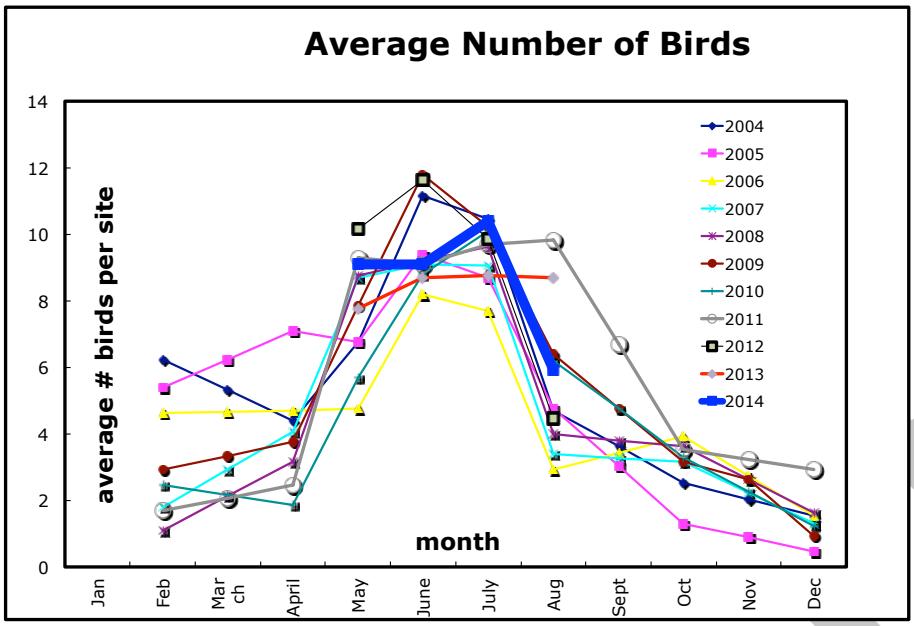


Figure 1.5 Mean number of birds at each point count location observed in all habitats in Cucumber Gulch, Breckenridge, CO 2004 - 2014.

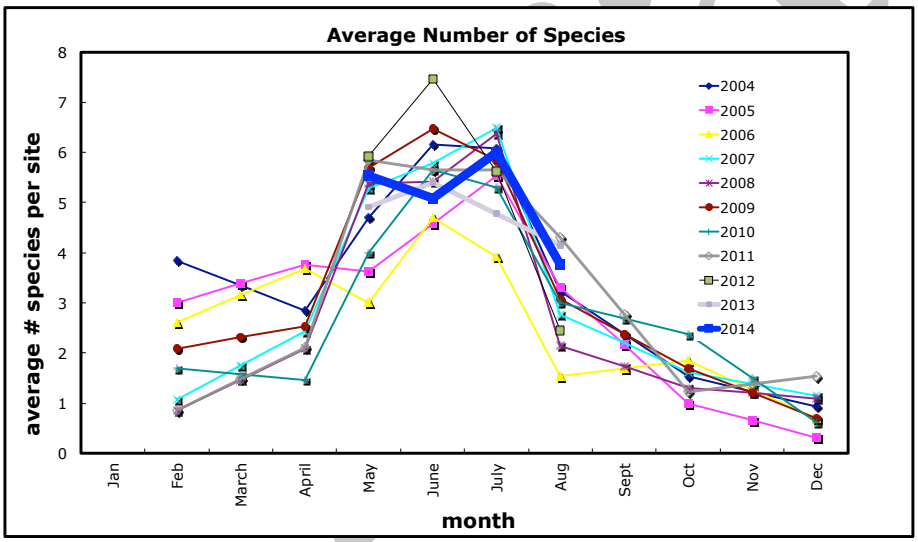


Figure 1.6 Mean number of species at each point count location observed in all habitats in Cucumber Gulch, Breckenridge, CO 2004 – 2014.

Peak numbers of individual birds and species have consistently been observed May through July (Figures 1.5 and 1.6). Average number of birds and species was within normal range in 2014. Migratory songbirds are mainly in the area from May to August with some arriving as early as February.

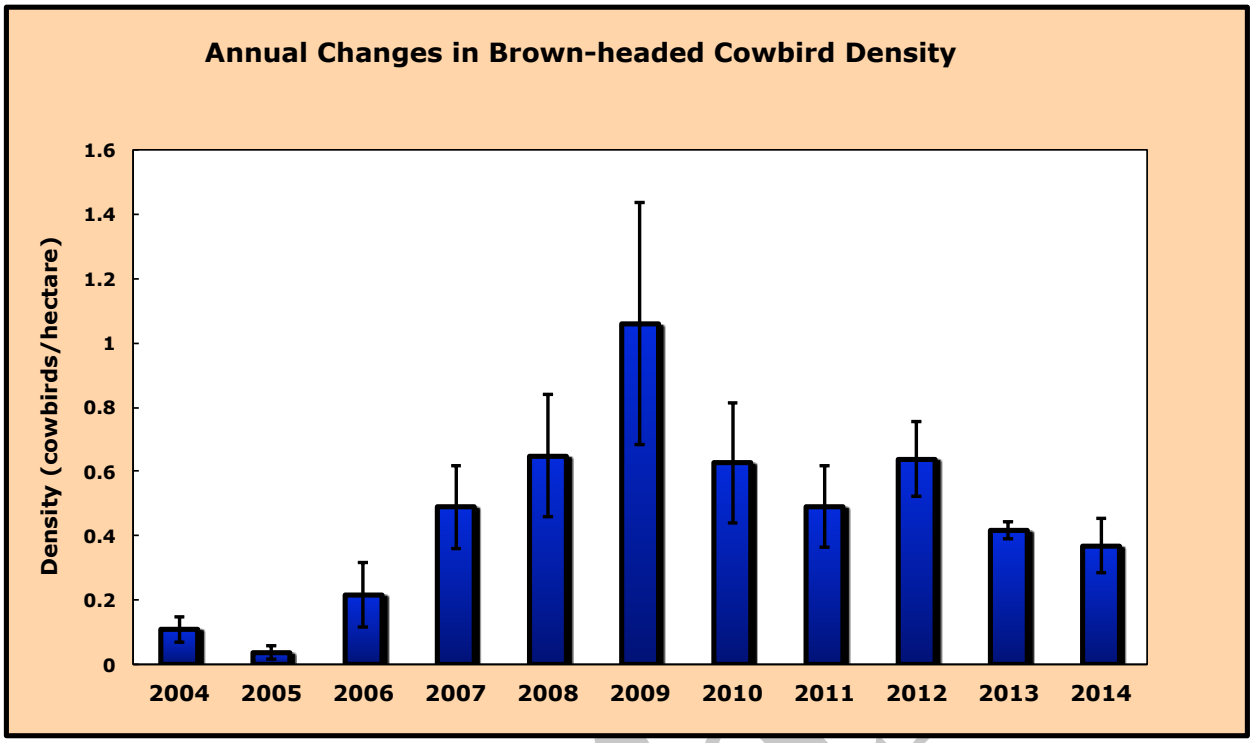


Figure 1.7 Average density of Brown-headed Cowbirds seen in Cucumber Gulch, Breckenridge Colorado during April, May, June and July point counts from 2004-2011 and May-July of 2012-2014.

Brown-headed Cowbirds are in Breckenridge from April to July. Brown-headed Cowbirds are nest parasites that lay their eggs in other birds' nests. The host birds incubate the cowbird's eggs and raise the cowbird's young, often at the expense of their own young. There was an overall significant increase in the number of cowbird sightings from 2005-2009 ($r^2 = 0.74$, $p = 0.01$; Figure 1.7). There was a decrease in the number of Brown-headed Cowbirds sighted during avian surveys from 2010 - 2014 compared to 2009. Brown-headed Cowbirds may have reached a saturation point and may be stabilizing around the 2008-2014 numbers.

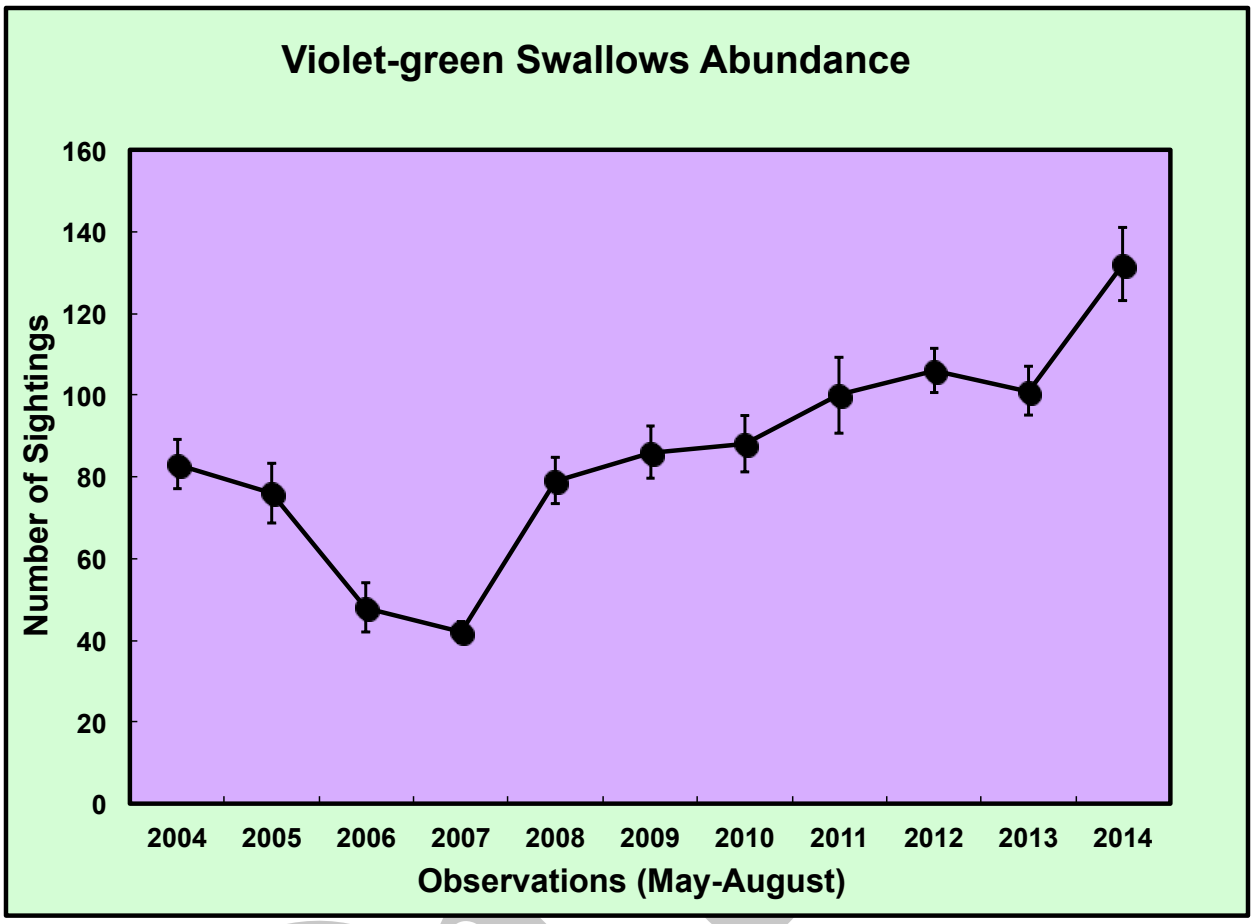


Figure 1.8 The number of Violet-green Swallow sightings in Cucumber Gulch, Breckenridge, CO in 2004 - 2014.

There was a 45% decrease in the number of Violet-green Swallows (*Tachycineta thalassina*) seen in Cucumber Gulch between 2004 and 2007 (Figure 1.8). Violet-green Swallow numbers noticeably decreased from 83 and 76 individuals seen in 2004 and 2005 respectively, to 48 and 42 individuals in 2006 and 2007. This drop in the number of birds may be a result of the tree removal operation and construction sounds of the gondola and the Peak 7 development that began in April of 2006. Violet-green Swallows are particularly sensitive to anthropogenic activity and depend on mature trees with pre-existing cavities for nesting. The Violet-green Swallow population appears to have rebounded in 2008 and has shown an overall trend of increasing with the highest numbers recorded in 2014.

1.4 Aquatic birds

Aquatic birds include both shorebirds and waterfowl. Surveys were conducted throughout the breeding season, mainly during regularly scheduled bird surveys and gondola bird surveys. All aquatic birds that were seen or heard were recorded. Aquatic birds observed in 2013 include Mallards with chicks (*Anas platyrhynchos*), Common Snipes (*Gallinago gallinago*), Spotted Sandpipers (*Actitis macularia*), Canada Geese (*Branta canadensis*), Great Blue Heron (*Ardea herodias*) and Green-winged Teals (*Anas crecca*).

1.5 Conclusions – terrestrial and aquatic birds

The diversity of habitat found in Cucumber Gulch provides numerous niches for avian species that are both generalists and specialists. The wetland habitat made up mostly of shrubland vegetation is a rare habitat in Colorado and attracts species that are not found in other habitat types. Thus far 65 species have been identified in Cucumber Gulch. Overall, the avian population warrants continued monitoring to determine if the decrease in avian abundance, species richness and species diversity in mixed conifer habitat and shrubland habitat is simply part of the natural fluctuation of birds or indicative of habitat degradation. One possibility is this result may indicate a reduction in habitat specialists and increase in generalists.

The most frequently observed predatory bird was the Cooper's hawk (*Accipiter cooperii*). The Olive-sided Flycatcher (*Contopus cooperi*) was observed several times in 2011, but not in 2012, 2013 or 2014. The U.S. Fish and Wildlife Service currently lists the Olive-sided Flycatcher as a Species of Conservation Concern, and it has been included as a priority species for conservation on Watch Lists for both Partners in Flight and the National Audubon Society. The American Three-toed Woodpecker (*Picoides tridactylus*) was newly identified in 2009 and has been observed every year since. This species is considered a rare bird in Colorado and a sensitive species by the USDA Forest Service (USFS) for Region 2, which includes Forest Service land near Breckenridge. The National Forest System considers a species sensitive if its population viability has shown or is predicted to show a downward trend in abundance or habitat requirements (Wiggins 2004).

Warbling Vireos (*Vireo gilvus*) had previously been observed in all habitat types in Cucumber Gulch. It is important to document the Warbling Vireo population because they suffer a relatively high rate of Brown-headed Cowbird (*Molothrus ater*) parasitism. Brown-headed Cowbirds have been observed in Cucumber Gulch and parasitism on a Hermit Thrush (*Catharus guttatus*) nest was documented in 2004. Warbling Vireos can have up to 80% of their nests parasitized by Brown-headed Cowbirds (Ward and Smith 1999). Parasitism on Warbling Vireos greatly reduces the number of successful fledglings (Ortega and Ortega 2003) and thus will ultimately have a negative impact on their population. It is common for Warbling Vireos to not produce offspring when parasitized. Brown-headed Cowbirds take advantage of forest edges. Vireos forced to nest in trees that are not deep within a forest are more susceptible to parasitism. Every

effort to minimize forest fragmentation and thus edges in Cucumber Gulch should be taken to protect the Warbling Vireo and other migratory songbirds from cowbird parasitism. Unfortunately Warbling Vireos have not been observed in Cucumber Gulch since 2009.

Colorado Partners in Flight lists the Cordilleran Flycatcher (*Empidonax occidentalis*), American Dipper (*Cinclus mexicanus)*, Olive-sided Flycatcher (*Contopus cooperi*) and Wilson's Warbler (*Wilsonia pusilla)* as priority species in the area (2000). American Dippers (*Cinclus mexicanus)* are also of special concern because they are indicators of water quality (Andrews and Righter 1992). An American Dipper was observed in 2014 in the upper portion of Cucumber Gulch. In addition, the USGS has listed the Wilson's Warbler (*Wilsonia pusilla)*, Fox Sparrow (*Passerella iliaca)* and Lincoln's Sparrow (*Melospiza lincolnii*) as management indicator species (Johnson and Anderson 2003, Johnson and Anderson 2004, Stephens and Anderson 2004). Unfortunately, only two Fox Sparrows have been seen since 2004, one of which was in 2013. Wilson's Warblers and Lincoln's Sparrows are a common bird in Cucumber Gulch.

Another important bird to watch is the Osprey (*Pandion haliaetus)*. The Osprey was once on the Endangered Species list and is considered a forest sensitive species in Colorado. They have been known to migrate as far south as Argentina. Ospreys historically were frequently spotted in the Gulch perched in trees adjacent to beaver ponds and flying over the ponds. Fish are the primary food source for Osprey. Ospreys were not observed in Cucumber Gulch between 2005-2012, and one Osprey was seen in 2013 and in 2014.

The migratory status of each species is listed in the Appendix. This species list is a list in progress that will likely be expanded as additional species are observed during future monitoring. Resident species can be found in Cucumber Gulch during all months of the year. Altitudinal migrants migrate to lower elevations during the winter. Short-distance migrants migrate south of Colorado. Neo-tropical migrants migrate south of the Tropic of Cancer for the winter. These birds are typically the last to arrive to breed in Cucumber Gulch and are among the first species to leave in the fall.

2.0 BEAVER POPULATION

2.1 Background – Beaver

Cucumber Gulch is inhabited by two species of semiaquatic rodents; the American beaver (*Castor canadensis)* and the common muskrat (*Ondatra zibethicus)*. It is vital to monitor these two species of wetland engineers as an index of wetland health and stability.

Beaver were nearly erased in North America by the early 20th century as a result of fur trading and land drainage for agriculture. Since that time, federal protection has prevented complete extinction and beaver numbers in North America have climbed to an estimated 10 to 15 million. Sadly, this is a mere fraction of the estimated 100 to 200 million alive before the time of the North American fur trader (Müller-Schwarze & Sun 2003).

Beaver dams are the primary way wetlands are naturally established. Removal of beaver has historically led to eradication of wetlands. The ponds and meadows formed by beaver dams provide prime habitat and foraging sites for birds, amphibians (especially the endangered boreal toad), fishes, and mammals such as ungulates and canids. The beaver are a keystone wetland species and the management and protection of the population continues to be a priority in Cucumber Gulch.

2.2 Methods – Beaver

2.2.1 Lodge Study

Beaver activity and lodge surveys have been conducted every autumn since 2003. This year surveys were done in November by Christy Carello and Elizabeth Kelso. Beaver activity is centralized in two drainages located in shrub-wetland habitat in Cucumber Gulch. The main and largest drainage runs in a northeast direction from A4 to D1 and the second smaller drainage runs in a southeast direction from B3 to C2 (see Map 1.1). These areas were inspected for lodges, bank dens, dams and beaver paths/slides. A lodge or den was considered active based on the following criteria: nearly no vegetative growth on the mound, freshly chewed branches on the mound, freshly placed mud on the mound, a cache of newly clipped sedge in and/or near the pond, and a well maintained dam. A lodge or den was considered visited based on the following criteria: minimal vegetative overgrowth on the mound, presence of beaver paths/slides, nearby chewed vegetation and in the vicinity of a maintained dam. Global Positioning coordinates were recorded and sites photographed. Motion sensor camera data was also used to confirm beaver activity at one site.

2.2.2 Observation Study

Established methods were used for determining the relative abundance of beavers and muskrats in Cucumber Gulch (Engeman and Whisson, 2003). Surveys were conducted monthly from June through August 2014. We surveyed the four traditional sites plus one new site which is located at the bottom of the main drainage near D1(table 2.1). These five sites are located in prime beaver habitat and were chosen based on data collected from previous surveys. Trained observers were assigned to each of the sites and dawn and dusk observations were carried out for 45 minutes at each site. Visual observations of beavers and muskrats were recorded using binoculars and spotting scopes.

Table 2.1 Observational study locales.

Site #	GPS	Description of site
1	39°29.242'N 106°03.634'W	Located near gondola post 16. It provides a wide view of three ponds, a stump den (photo 2.9) and an inactive lodge (photo 2.8) in the eastern portion of the gulch.
2	39°29.062'N 106°03.664'W	Located in front of the bird interpretive sign. This site has a view of four actively worked beaver ponds. Dams continue to show evidence of recent work as well. .
3	39°29.049'N 106°03.812'W	Historic lodge located at the beaver interpretive sign (Photo 2.4). This site continues to be a heavily worked and the lodge is active.
4	39°28.917'N 106°03.997'W	Located on Ski Hill Road near the Peak 8 Super Lodge at the highest point of the gulch. Several actively worked ponds are within view as is a new stump den.
5	39°29.290'N 106°03.572'W	Located ~50m NW of Site 1 near the bottom of the main drainage within view of Josie's cabin. It provides a panoramic view of several ponds and inlets plus one semi-active stump den (photo 2.2).

2.3 Results - Beaver

2.3.1 Lodge Study Results

November surveys revealed eleven various lodges and dens throughout the wetland (Table 2.2; Photos 2.1-2.11). Three of these sites were deemed currently active beaver dwellings. First is the historically active lodge at the beaver interpretive sign (photo 2.4). Multiple beaver continue to work and occupy this lodge as is evidenced by the motion sensor camera photographs. The second active lodge is located ~100m north of the moose interpretive sign (photo 2.7). This lodge features an enormous cache and ample evidence of maintained dams (photos 2.15, 2.16). Neither of these lodges are new structures in 2014 although the latter is newly active again this year. The third active dwelling is a new bank den located under a tree stump at the very top of the main drainage close to A4 (photos 2.9, 2.17, 2.18). Beaver kits were observed and photographed at this site by the hydrology team.

Two other new tree stump bank dens were discovered this year (photos 2.10, 2.11). Although not considered completely active dwellings, both were visited by beaver in 2014. Stump bank den 2014-11 was also monitored by the hydrology team this summer and in August their den camera photographed two beavers using this den. At that time the pond was full and the dam well maintained. By the October walk-thru, the pond at this stump den was completely drained due to dam failure (photo 2.23). Both hydrologists, Jessica Doran and Mark Beardsley, agree that the dam failure was under the face of the dam and not over the top. There was no obvious increase in sediment load and the hydrologic regime did not change dramatically so this was deemed a localized event, not a systemic problem. Beaver ceased to maintain this dam for unknown reasons. One plausible explanation for the dam blow out could be subterranean holes made in the dam by muskrat, as they are known for that behavior.

An established bank den in the northern-most pond also appears to be visited but not actively maintained (photo 2.2). A similar type established bank den near a stagnant pond also appears to be visited but not actively used (photo 2.3). It is possible that these two dens are muskrat dwellings. The surrounding areas near both of these visited dens shows ample evidence of dam maintenance and beaver foraging (photos 2.12, 2.13).

Of the eleven dwellings observed only three appear completely inactive in 2014 (photos 2.1, 2.5, 2.8). Figure 2.1 depicts the trend of active beaver lodges observed since 2000.

Table 2.2: Summary of beaver lodges and dens documented in Cucumber Gulch in October and November 2014.

ID #	GPS	2014 Status	Photo Number
2014-1	39°29.306'N 106°03.524'W	Inactive lodge	2.1
2014-2	39°29.287'N 106°03.566'W	Visited bank den	2.2

2014-3	39°29.980'N 106°03.829'W	Visited bank den	2.3
2014-4	39°29.026'N 106°03.808'W	**Active** lodge	2.4
2014-5	39°29.055'N 106°03.731'W	Inactive lodge	2.5
2014-6	39°29.029'N 106°03.745'W	Visited lodge	2.6
2014-7	39°29.143'N 106°03.602'W	**Active** lodge	2.7
2014-8	39°29.174'N 106°03.570'W	Inactive lodge	2.8
2014-9	39°29.167'N 106°03.572'W	Visited bank den under evergreen trees	2.9
2014-10	39°28.917'N 106°03.997'W	**Active** tree stump bank den	2.10
2014-11	39°29.118'N 106°03.732'W	Visited bank den under spruce tree	2.11

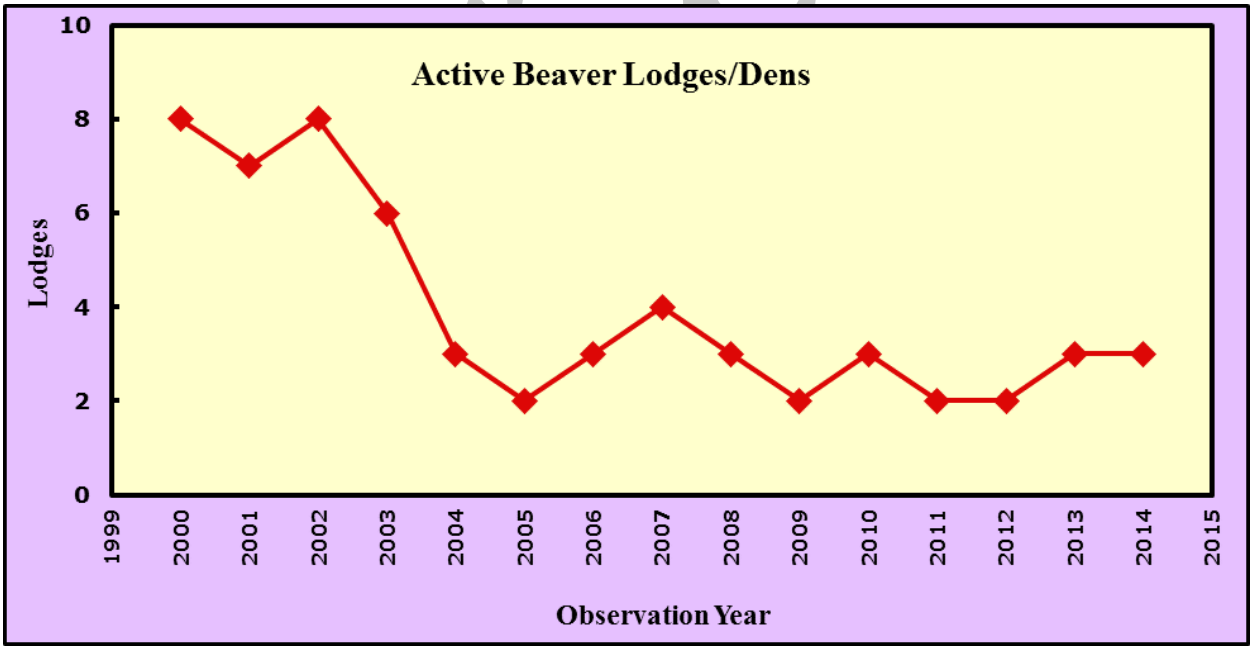


Figure 2.1 Active Beaver lodges and bank dens in Cucumber Gulch, 2000-2014.

2.3.2 Observational Study Results

The addition of one more observation site this season, yielded more beaver sightings overall (Table 2.3). However, when comparing 2013 sightings to 2014 sightings, (excluding the new site) there was not a significant change in the average number of beaver sighted overall ($\bar{X}$ = 3.3 & 5.6; $p>0.05$).

Eight beaver were sighted at site five, the new site located by the northern most ponds at the bottom of the main drainage. Two beavers were often sighted at the same time transiting throughout this area and going about their work. There is a bank den (photo 2.2) in the largest pond and beavers were observed swimming and diving near it but not working on the mound.

Six beaver were sighted at site one, an established site located by gondola post 16. There is an interesting bank den (photo 2.9) visible from this site which is situated far up the bank under two evergreens. The beaver were not actively working on the mound but it was not overgrown either. Beaver were seen diving repeatedly at the same spot near this bank, which could be an underwater entrance.

There were two beaver observed at site two by the bird interpretive sign. An established active lodge (photo 2.7) is within view of this site, however no beaver work was observed on the lodge during this time.

Only one beaver was sighted at site four which is located on Ski Hill Road across from Peak 8 at the top of the main drainage. There is a new active stump bank den (photo 2.10) in the northernmost pond at this site. The hydrology team photographed kits at this den and there are is a cache and well maintained dams.

There were no beaver sighted at site three, the most established and historic lodge located at the beaver interpretive sign (photo 2.4). There is a motion sensor camera on this lodge and beavers were only captured on it three times between January and September and it appeared this lodge was not being actively worked during that time (photo 2.20). The beaver began work in earnest come October and the lodge was classified as active once again (photo 2.21).

Muskrats were observed five times at site five, three times at site one, two times at site two and once at both sites three and four. Regardless of the additional site, there was no significant change in the total number of muskrats observed in 2014 (Table 2.3).

Table 2.3: Survey sightings of beaver and muskrat by month for 2012 through 2014. The numbers indicate animal sightings and not the number of individual animals.

	Beaver 2012	Beaver 2013	**Beaver 2014**	Muskrat 2012	Muskrat 2013	**Muskrat 2014**
June	9	3	**4**	5	5	**5**
July	7	4	**5**	6	3	**4**

August	5	3	**8**	1	2	**3**
Total	21	10	**17**	12	10	**12**

2.4 Conclusions - Beaver

Beaver were observed throughout Cucumber Gulch on numerous occasions from July to August 2014. As the beavers are not tagged it is impossible to determine individual animals but we were able to identify one large adult beaver this year due to a noticeable scar on his right hindquarter (photos 2.21 & 2.22). This beaver was captured on camera at two different sites and observed in person twice. Beaver kits were observed and photographed this year by the hydrology team, giving clear evidence of reproductive success. Overall, beaver productivity seemed to increase as there were three completely new tree stump type bank dens this year and beaver activity was observed at all of them. The number of active lodges continues to hold steady at three in 2014, although not always the same lodges are active from year to year.

References:

Müller-Schwarze, D., & Sun, L. (2003). *The beaver: natural history of a wetlands engineer*. Cornell University Press.

Engeman, R.M. and Whisson, D.A. (2003). A visual method for indexing muskrat populations. International. *Biodeterioration & Biodegredation*. Vol 52. pp. 101-106.

2. 5 Photographic documentation of beaver activity

Photo 2.1 2014-1; near gondola post 15, between D1 and SW4; lodge continues to be inactive.

Photo 2.2 2014-2; small bank den between gondola posts 16 and 15, near SW4 and C2; while no cache was observed, pond banks are maintained and beaver observed several times; this den is visited but not considered active

Photo 2.3 2014-3; small bank den situated on ground next to stagnant pond ~ 100m SSW of beaver interpretive sign; no cache was observed; well used slides nearby (photo 2.12); stagnant pond shows no evidence of beaver work; pond directly east has recently maintained dam (photo 2.13); den is visited but not considered active.

Photo 2.4 2014-4; next to Camera 5 and beaver interpretive sign; lodge shows signs of recent activity and camera has photographed recent activity; pond dams are being actively maintained and nearby trees felled(photo 2.14); this lodge is considered active.

Photo 2.5 2014-5; large old lodge ~150m west of beaver interpretive sign; there continues to be no apparent indication of beaver work on or near this inactive lodge.

Photo 2.6 2014-6; small lodge is ~75m ESE of beaver interpretive sign; no apparent indication of beaver activity on or near this inactive lodge.

Photo 2.7 2014-7; established large lodge ~100m north of moose interpretive sign; huge cache and ample evidence of beaver chew nearby (photo 2.15); nearby dam is being actively worked (photo 2.16); this lodge is active.

Photo 2.8 2014-8; large lodge is ~100m NNE of moose interpretive sign; no apparent indication of beaver activity on or near this inactive lodge.

Photo 2.9 2014-9; new stump den located at top of Gulch; evidence of dams being worked; cache located outside of den (photos 2.17 & 2.18); kits were observed here by the hydrology team; this den is active.

Photo 2.10 2014-10; small bank den located in between and under two large evergreens; transiting beaver were observed nearby during surveys; this den is visited but not considered active.

Photo 2.11 2014-11; sizable stump den with two entrances; situated on the pond bank underneath a large spruce tree; this den appears visited (photo 2.19) but not active.

Photo 2.12 Well used slide located in the pond adjacent the visited bank den 2014-3.

Photo 2.13 Maintained dam near visited bank den 2014-3.

Photo 2.14 A tree felled by a beaver near active lodge 2014-4.

Photo 2.15 Fresh beaver chew by active lodge 2014-7.

Photo 2.16 Well maintained dam at pond where active lodge 2014-7 is located.

Photo 2.17 Dam work on pond adjacent the new active stump den 2014-10. Beaver were observed working here during surveys.

Photo 2.18 Dam work here has begun to create another small pond near the new active stump den 2014-10.

Photo 2.19 Chewed root is part of the visited underground bank den 2014-11; chew was fresh when den was discovered in July.

Photo 2.20 Lodge 2014-4 on July 27, 2014. The lodge does not appear worked at this time.

Photo 2.21 Lodge 2014-4, October 7, 2014. Two beaver began working on the mound at this time. The beaver on the mound has an identifying scar on his hindquarter.

Photo 2.22 This beaver has a scar on its' right hindquarter, making it possible to identify him several times in 2014

Photo 2.23 This pond, located by stump den 2014-11, was completely drained by

3.0 BOREAL TOADS

3.1 Introduction –boreal toads

The continued global threat to amphibian populations worldwide mandates the identification of current breeding populations of amphibians. The significant fen wetland system located in Cucumber Gulch provides suitable habitat for both the western chorus frog (*Pseudacris triseriata*) and the endangered subspecies of boreal toad (*Bufo boreas boreas*). The boreal toad is especially at risk of local extinction due to habitat loss and susceptibility to the chytrid fugus (*Batrachochytrium dendrobatits)*. Chytrid fungus is the primary pathogen responsible for the statewide die-off of boreal toads (Keinath & McGee 2005). Testing on two individual frogs found in Cucumber Gulch in 2005 was negative for the fungus.

3.2 Methods –boreal toads

Cucumber Gulch was surveyed for amphibian populations in June, July, and August of 2014. Proper protocol was followed based on established techniques (Loeffler 2001). Field technicians underwent training prior to conducting surveys in the field. All surveys involved a minimum of three technicians and were supervised by Elizabeth Kelso.

3.3 Results –boreal toads

Although no boreal toads, larvae or eggs were found during the 2014 toad surveys there were two separate confirmed sightings outside of the survey time periods. The first toad was spotted by Christy Carello in mid-June at the following GPS coordinates: N39°29.191 & W106°3.637. The second toad was observed by Elizabeth Kelso at 8pm on July 5th at the following GPS coordinates: N39°29.224 & W106°3.649. Neither toad was captured or photographed, nonetheless it is the first confirmed sightings of boreal toads in Cucumber Gulch since 2005.

3.4 Conclusions – boreal toads

Cucumber Gulch is a wetland system that has historically had boreal toads. The confirmed sightings of toads in 2014 reveals that they are still using the habitat and that surveys should continue in 2015 with the hope of documenting breeding.

New Citation:

Keinath, D. and M. McGee. (2005, May 25). Boreal Toad (*Bufo boreas boreas*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/borealtoad.pdf [Feb 5 2014]

4.0 MOTION SENSOR CAMERA WILDLIFE MONITORING

Monitoring with motion sensor cameras (Silent Image Model RM30; Reconyx.com) continued throughout 2014. The five cameras have been in place since 2008 (Map 2). Cameras were operative most days throughout the year with very few days down in 2014 (Table 4.1). Cameras were placed at known areas of animal and human use. The cameras are infrared and silent, thus observations have been made without the effect of human disturbance. Each camera uses a 2GB memory card capable of holding up to 4,000 photos per card. Memory cards are methodically changed every 2-3 weeks. This method of data collection should continue as it allows us to view wildlife in its natural state and gives wildlife managers valuable decision making information.

The 2014 field season has yielded thousands of animal photographs captured on the motion sensor cameras. Cucumber Gulch continues to be used by a variety of species throughout the year. The following are the captures for 2014 from greatest to least: deer, moose, fox, human, aquatic birds, squirrel, coyote, beaver, terrestrial birds (photo 4.1), bear (photo 4.2) and five other species of small mammal (Fig 4.1).

The number of bear, coyote (photo 4.3), raccoon, squirrel, snowshoe hare, porcupine and muskrat captures did not change significantly in 2014. This was the second year in a row that we captured porcupine several times (Photo 4.4). Pine marten captures were significantly less frequent at 3/year. The number of fox captures nearly doubled to 158/year in 2014 (photo 4.5). Raccoon captures increased slightly from 1/year in 2013 to 6/year in 2014.

Deer captures continued their steady increase in 2014 to 300/year. The majority of deer captures were on camera four (Photo 4.10). Moose captures increased from 158/year in 2013 to 249/year in 2014 (Photos 4.6- 4.9). As seen in previous years, moose were captured mostly on cameras two and one respectively. Of particular interest this year, a bull moose fell in a sink hole located in front of camera two. He struggled for nearly a minute until climbing out and the whole incident was captured on camera (Photos 4.18 & 4.19). This sinkhole series will be a valuable docent tool when educating tourists about wetland safety and the value of staying on groomed trails.

The number of beaver captured on camera five (the reset pond restoration site) decreased significantly in 2014. The decrease in captures was likely a combination of two factors. The first being, from January through April we were still attempting to find a suitable spot for camera five since the tree it was installed on fell in December 2013. It is possible that the camera was too far away to trigger on lodge activity from January through April. There is photographic evidence that the lodge was actively maintained through the end of May (photo 4.11). The second factor was that the lodge located at camera five was not the main focus of the beaver's attention in summer 2014 and only became fully active in again in November (Photos 4.12 & 4.13). There was not a camera situated at the most active summer 2014 beaver locales, lodges 2014-7 and

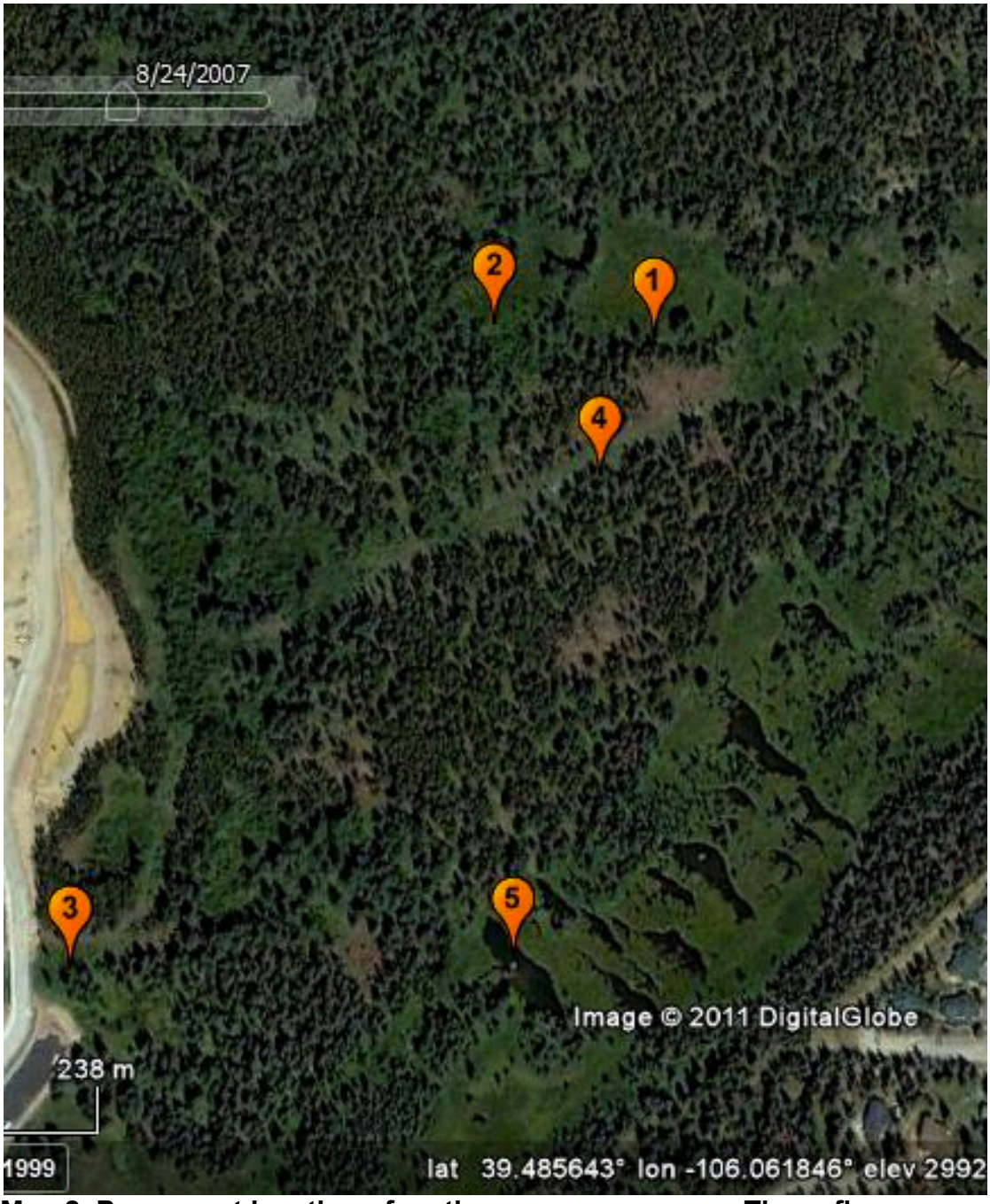
2014-10. To capture a more accurate picture of beaver activity in 2015, it is advisable to install additional cameras at both of these active lodges as soon as possible. The number of crows remained low at 2/year in 2014, a continued testament to the restoration at the reset pond. The number of aquatic bird (ducks and geese) captures on camera five declined by half in 2014 to 30/year. While aquatic bird captures are down from 2014, this is still a significant increase from the 2/year captured in 2011 before the area was restored (Photo 4.14)

Off trail humans and canine presence are still of concern throughout the Gulch, particularly at camera three which is an important wildlife corridor (Photos 4.15 & 4.16). The number of people captured off trail declined slightly from 122/year in 2013 to 89/year in 2014. There was an increase in the number of dogs (mostly off leash) captured on the off trail cameras from 2/year in 2013 to 6/year in 2014 (Photo 4.17). Dogs continue to be of concern for wildlife in the Gulch. It is once again recommended to not only increase the number of no dogs allowed signs but to truly consider the quality and visibility of the signs being placed. It is also recommended that the docent program be continued this summer and perhaps expanded to include a volunteer docent at the beaver interpretive area where an active lodge is located.

Peak numbers of animals were photographed from March through October (Fig 4.2 & 4.3). In figure 4.2 and 4.3 the spikes seen on camera four in June and August were from deer and the spike seen on camera three in June was from fox.

Table 4.1 Inoperative camera dates, GPS coordinates of motion sensor cameras and date of installation. Camera two was operating July 1-7 but a moose butt nudged the camera so it was focused on the ground. The other inoperative days were from battery failure.

Camera number	GPS Coordinate	Camera installation date	# of days camera inoperative	2014 Dates camera inoperative
Camera 1	N 39°29.205 W 106°03.732	December 17, 2007	0	N/A
Camera 2	N 39°29.222 W 106°03.812	December 17, 2007	15	1 July – 7 July 10 July – 18 July
Camera 3	N 39°29.028 W 106°03.983	January 12, 2008	0	N/A
Camera 4	N 39°29.179 W 106°03.769 N	January 12, 2008	0	N/A
Camera 5	N 39°29.019 W 106°03.803	May 18, 2008	4	27 July – 31 July



Map 2. Permanent location of motion sensor cameras. These five cameras have been in place since 2008.

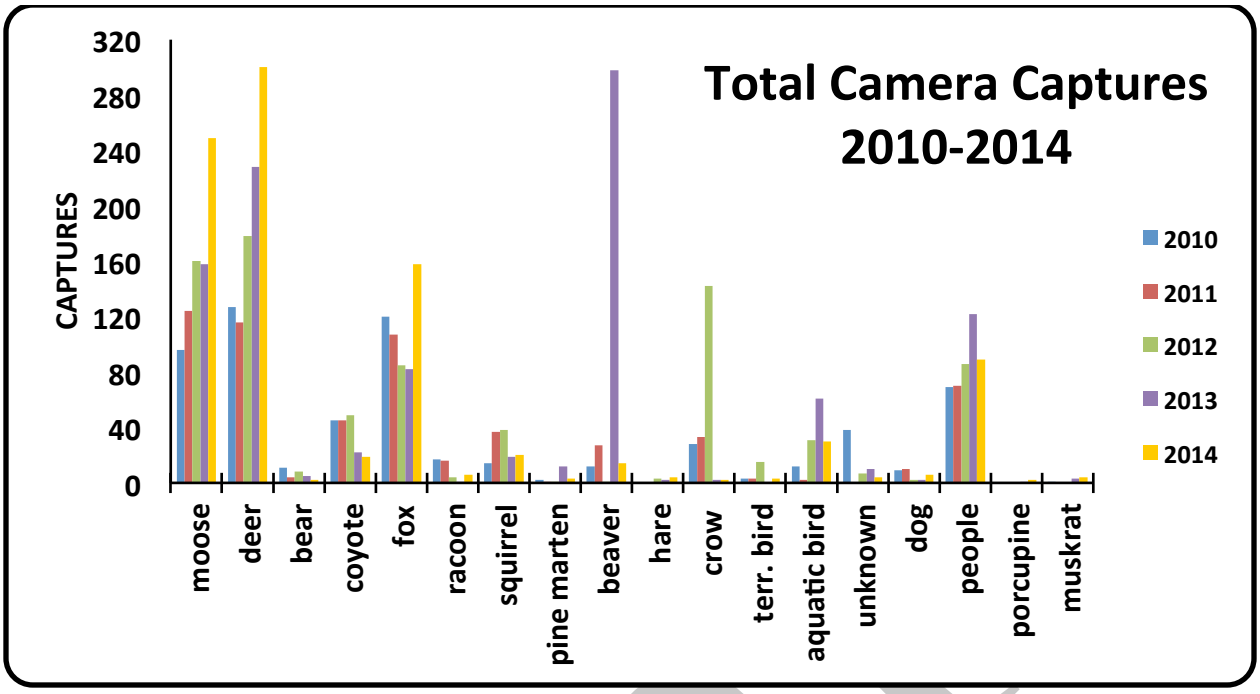


Figure 4.1The total number of camera captures for individual species in 2010 (blue), 2011 (red), 2012 (green), 2013 (purple), and 2014 (orange). A camera capture is defined as a single photo or the first photo in a series of photos.

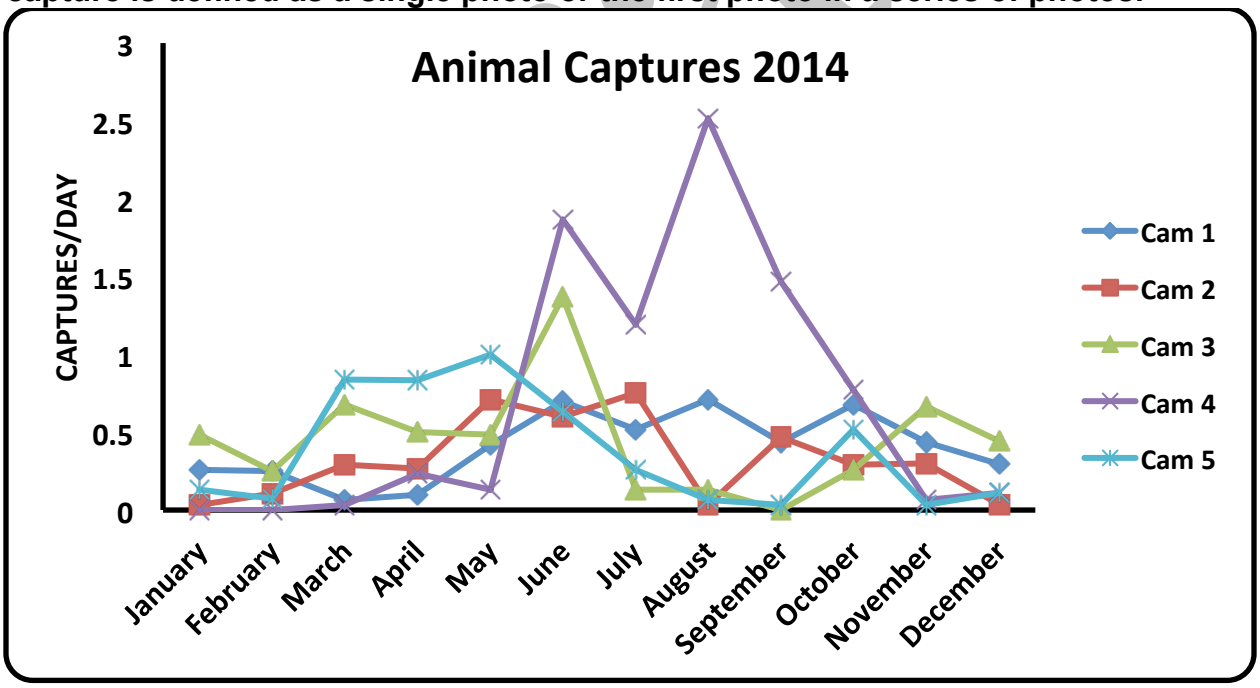


Figure 4.2. The number of camera captures per day for each month the camera was operational (total monthly captures divided by operational days per month). The legend at the right is camera number. A camera capture is defined as a single photo or the first photo in a series of photos. Of note; camera 4 June and August spikes were deer and camera three June spike was fox. This graph does not include humans and dogs.

Photo 4.1 Hummingbird at camera five on August 8th at 7:29am. Notice the beaver lodge is not active at this time.

Photo 4.2 A black bear at camera one on August 19th at 5:40am.

Photo 4.3 A coyote with a fresh kill at camera three on November 1st at 12:31pm.

Photo 4.4 A porcupine at camera three on May 2nd at 7:52pm.

Photo 4.5 A curious fox checks out camera four on September 14th at 8:08pm.

Photo 4.6 A moose takes a dip in the pond by camera five on June 3rd at 3:52pm. Notice the lodge still appears active at this time.

Photo 4.7 A moose calf yawns as it wakes from a long nap in front of camera one on June 4th at 11:08am.

Photo 4.8 For the first time ever, moose copulation was captured at camera two on October 13th at 11:05am.

Photo 4.9 A moose cow urinates in front of camera two, a popular moose locale, on November 4th at 9:44am.

Photo 4.10 Two deer fawn frolic for ten minutes in front of camera four on August 20th at 7:10pm.

Photo 4.11 A heron forages in the pond by camera five on May 30th at 10:03am. Notice the beaver lodge is still active at this time.

Photo 4.12 The beaver resume work on the lodge by camera five, November 9th at 9pm.

Photo 4.13 A fox checks out the active lodge by camera five On December 7th at 8pm.

Photo 4.14 Two male mallard ducks forage in the pond by the active lodge at camera five on May 5th at 11:41 am.

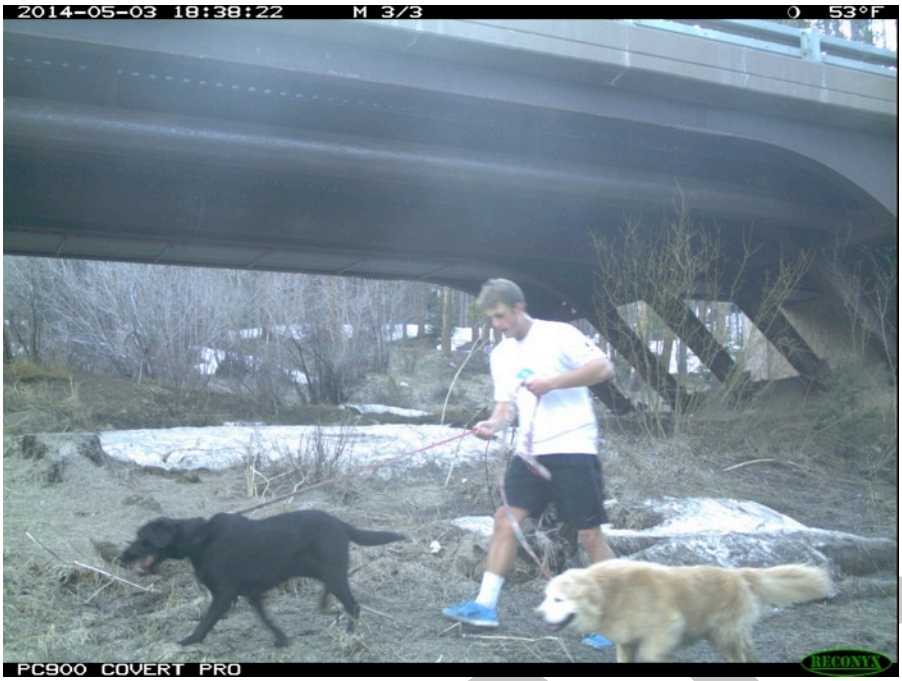


Photo 4.15 A human and his two dogs hiking off trail at a vital wildlife corridor located at camera three on May 3rd at 6:38pm.

Photo 4.16 An off leash dog captured in front of camera three on November 5th at 1:04pm.

Photo 4.17 An off leash dog and its humans captured in prime moose habitat by camera one, March 30th at 5:20pm.

Photo 4.18 A moose falls into a sinkhole in front of camera two on September 13th at 7:31pm. He struggles for nearly a minute before getting out.

Photo 4.19 The moose continues to struggle to escape the sinkhole in front of camera two.

Photo 4.20 The bull moose is finally able to climb out of the sinkhole in front of camera two on September 13th at 7:32pm.

5.0 RECREATION TRAIL CAMERA 2014

5.1 Introduction – Recreation Camera

In 2011 a trail camera study was carried out in Cucumber Gulch to investigate the impact of summertime human recreation activities on wildlife habitat usage. The results indicated that animals such as deer, fox and coyote were likely habituated to predictable human disturbance, as they did not vacate the Gulch once the trails were open in July. The study demonstrated that moose cows and calf pairs have zero tolerance for human presence. In June, when the trails were closed and human disturbance was low, moose pairs were captured often on the trail cameras. However, when the trails officially opened in July moose camera captures significantly declined with moose abandoning the trails all together (Carello, 2011).

Moose cows are likely more sensitive to human disturbance in June and July when newborn calves are still young and vulnerable. Beginning in 2012, in an effort to minimize the amount of stress and energetic demands placed on new cow/calf pairs, it was decided that the recreation trails be closed through the 4th of July weekend.

In the interest of investigating the effect of this closure and to continue monitoring trail use in the Gulch the most fruitful trail camera from the 2011 study was placed on the recreation trail in June and July 2012, 2013 and 2014.

5.2 Methods - Recreation Camera

In May 2014 one motion sensor camera (Hyperfire Image Model PC 900 available from Reconyx.com) was installed on the recreation trail at the gondola corridor. This was the same location of Camera 9 in the 2011 study. The camera uses a 2GB memory card capable of holding up to 4,000 photos per card. Memory cards were methodically changed every 2-3 weeks. A camera capture is defined as a single photo or the first photo in a series of photos. The camera was removed from the trail at the end of July 2014.

5.3 Results - Recreation Camera

Despite someone trying to unsuccessfully sabotage the camera on July 17th, nearly 5000 individual photos were taken during June and July 2014. When the trails were closed in June there was a total of 100 individual humans captured on camera, a significant decrease from the 274 individuals captured in June 2013 and a highly significant decrease from the 348 individuals captured in June 2012 (Table 5.1, Figure 5.1).

The trails were officially closed July 1-6, 2014. When compared to the same time period in 2013, there was a highly significant decrease in the average number of humans captured on the trail camera in (Table 5.1, Figure 5.2), thus indicating the trail closure was significantly more effective at reducing human traffic in 2014 than it was in 2013. Yay!

When the trails opened on July 7th 2014 the number of individual humans increased exponentially from when trails were closed in June (Table 5.1). When compared to July 2013, there was a significant increase in the average number of humans using the trails in July 2014 (Figure 5.3). There continues to be a steady increase in the average person per day since monitoring began in 2011.

Once again, there was no statistical difference between the number of humans per day when comparing weekdays to weekends in 2014 (Figure 5.4). Day hiking, mountain biking and trail running comprised 62%, 32% and 6% respectively of the trail use activities (Figure 5.5). Dogs were captured on the trail camera 34 times in 2014 and 22 of them were off leash.

The animals photographed included moose (photo 5.1), deer, fox, coyote, bear (photo 5.2), snowshoe hare (photo 5.3), and raccoon (Table 5.1). When comparing June and July 2013 to June and July 2014, there was no significant difference in the average number of deer per day (Figure 5.6). When comparing June 2013 to 2014, there was no change in the average number of moose camera captures per day (Figure 5.7).

5.4 Conclusion - Recreation Camera

The decision to keep the recreation trails closed over the July 4th holiday weekend once again prevented the holiday weekend spike in human activity that was observed in previous years. There were vast improvements in trail closure signage and barriers in 2014 and that, combined with the trail docent program, had a huge effect in decreasing the average number of humans using the trails when they were closed. The average number of humans using the closed trails 4th of July weekend in 2014 decreased more than sevenfold from 2013. The average number of humans using the closed trails during June 2014 decreased threefold from June 2013. This is a wonderful success and the next logical step would be to focus efforts on reducing the number of humans who are hiking around the gulch off the official trails as this continues to be a problem partly due to insufficient signage in parts of the gulch and partly due to noncompliance.

The trails opened on July 7th and there was a significant increase in the average number of visitors in 2014 when compared to all previous years. The average number of people per day using the trails since 2011 has nearly tripled in 2014. If this trend continues we could see an average of 400 people per day by 2017!

The overall increase in summertime human trail recreation in 2014 did not deter the fox from using the trail and surrounding areas, although the number of fox seen at this site continues to be on a downward trend. There were no coyotes captured on camera in

July, also a continued downward trend. The number of small mammals on the trail was low again this year. Perhaps that would explain the steady decrease in coyote and fox caught on camera in this area, i.e. no prey, no predators.

There was no difference in the average number of deer when comparing 2013 to 2014 and the trend shows a steady increase in deer since 2012. Neither the deer nor the moose abandoned the gulch entirely and were observed quite often throughout the summer on the off trail cameras. The concern continues to be that human recreation is causing increased stress and energetic demands to newborn moose calf and mother pairs. Unlike other members of the deer family, moose are solitary animals. Moose cow and calf pairs do not have the benefit of a herd to alert them to danger. In addition, moose have poor eyesight and therefore are not depending on vision to detect danger but instead rely heavily on their keen hearing and sense of smell to alert them. The combination of moose behavior and physiology result in moose being quick to flee an area when danger is detected and we capture fleeing moose on camera regularly. The energy devoted to flight plus decreased time for foraging and increased stress come at the cost of energy resources that could be devoted to the individuals' survival, growth, and reproduction (Geist 1978). Unfortunately, once moose abandon a habitat they are not likely to return soon. Therefore it only takes one big disturbance and moose will vacate the area. Even though there was a significant reduction in human disturbance when the trails were closed we did not see an increase in the number of moose on the recreation camera. While the moose did continue to avoid the busy trail, there is ample evidence from other trail cameras that moose continued to use less disturbed parts of the gulch throughout the year.

There continues to be a significant number of people who bring dogs to the Gulch and/or think it is OK to hike off trail wherever they please. The majority of these visitors simply don't have a clear understanding of why no dogs are allowed or what the big deal is about off trail hiking or how these practices can negatively affect wildlife (Photos 5.4- 5.5).

In conclusion, it is recommended that the recreation trails continue to remain closed through the July 4th weekend in an effort to minimize ungulate disturbance and abandonment of the habitat. The docent program should continue to be implemented and expanded to include most of July when the trails are open as the educational outreach would reach more visitors (see Docent Program chapter). Studies show that recreationists are more likely to support restrictions if they have an understanding of how wildlife will benefit (Purdy etal.1987). The docent's task is to emphasize how human activities affect wildlife, helping visitors to associate their actions with either benefiting or harming animal populations. Klein (1993) found that visitors who spoke to wildlife refuge personnel were less likely to disturb wildlife than visitors who did not.

Table 5.1.The total number of individual humans and animals which were photographed on a recreation trail during June and July 2011 through 2014.

	June 2011 shut	June 2012 shut	June 2013 shut	June 2014 shut	July 1-8 2011 open	July 1-8 2012 shut	July 1-7 2013 shut	July 1-6 2014 shut	July 9-31 2011 open	July 9-31 2012 open	July 8-31 2013 open	July 7-31 2014 open
Human	96	348	274	100	709	91	189	23	1303	2512	2175	3640
Moose	14	5	4	4	0	0	0	0	0	3	1	4
Deer	37	24	30	33	7	3	5	9	51	28	24	61
Fox	9	21	3	8	1	2	0	1	9	3	0	1
Coyote	1	8	2	3	3	0	0	0	1	2	1	0
Bear	1	0	0	2	0	0	0	0	1	0	1	0
Small mammal	2	13	5	5	5	1	2	0	7	15	0	1

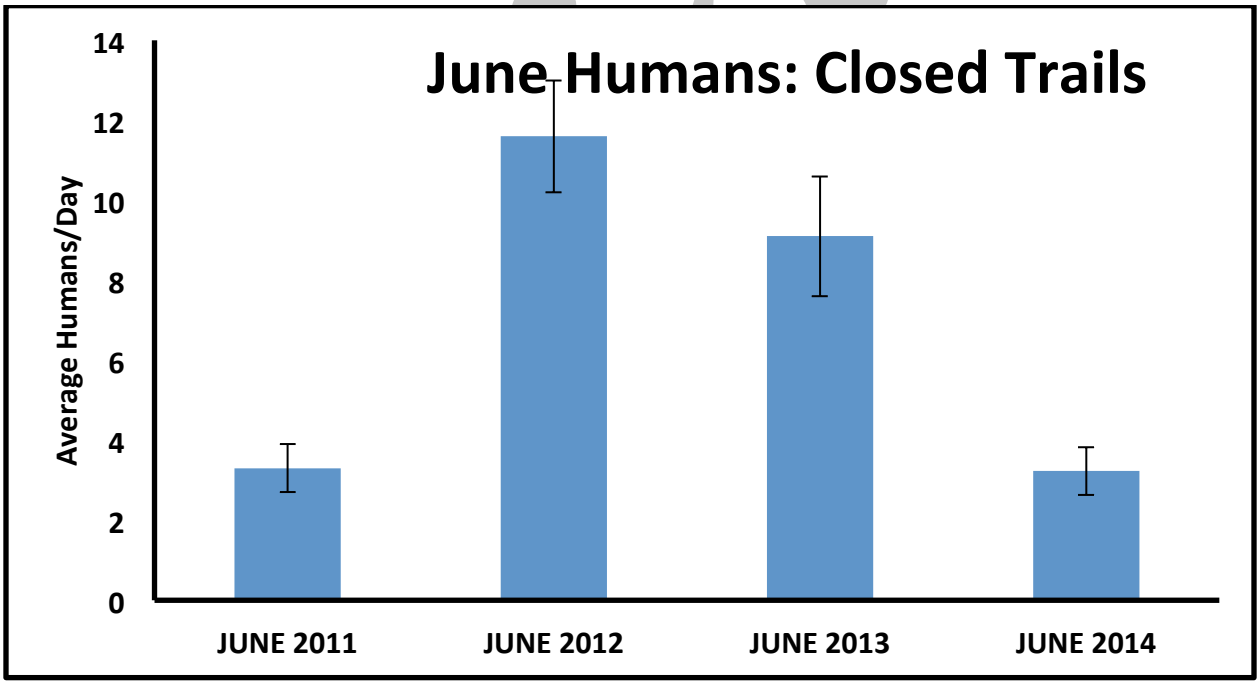


Figure 5.1.There was a significant decrease in the average number of humans captured on camera per day during the month of June from 2013($\bar{X}$ =9.1±1.5) to 2014($\bar{X}$ =3.3±0.6; p =0.001).

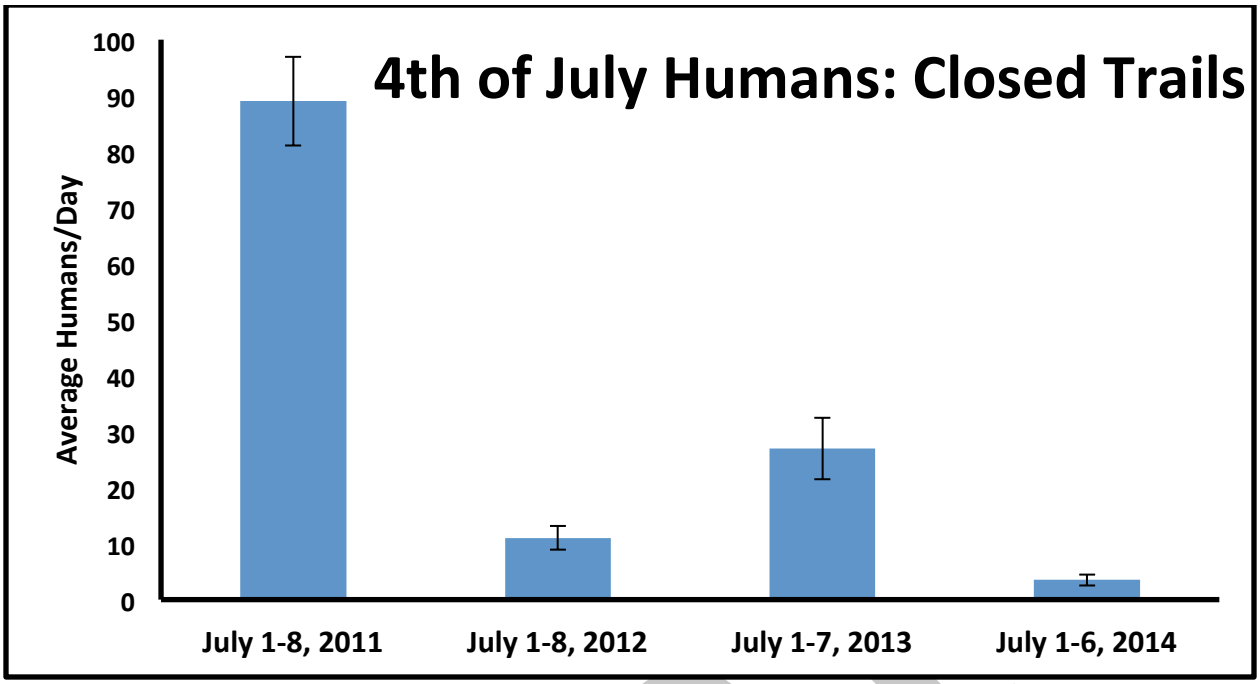


Figure 5.2 When comparing July 1-7, 2013 to the July 1-6, 2014 the average number of humans per day during this time period decreased significantly from 2013($\bar{X}$=27±5.5) to 2014 ($\bar{X}$=3.5±1; p = 0.001).

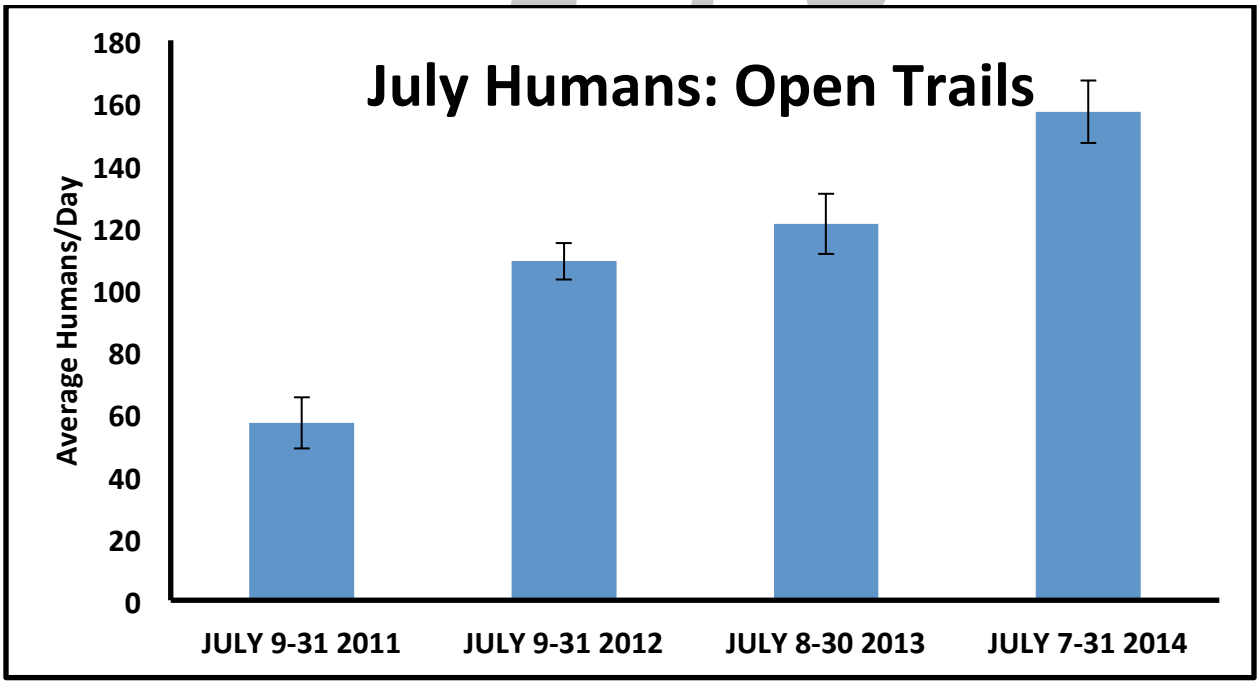


Figure 5.3 The average number of individual humans captured per day on camera in the month of July 2014 ($\bar{X}$= 157±10) was significantly greater than the average number of individual humans captured per day on camera in July 2013 ($\bar{X}$=121±9.7).

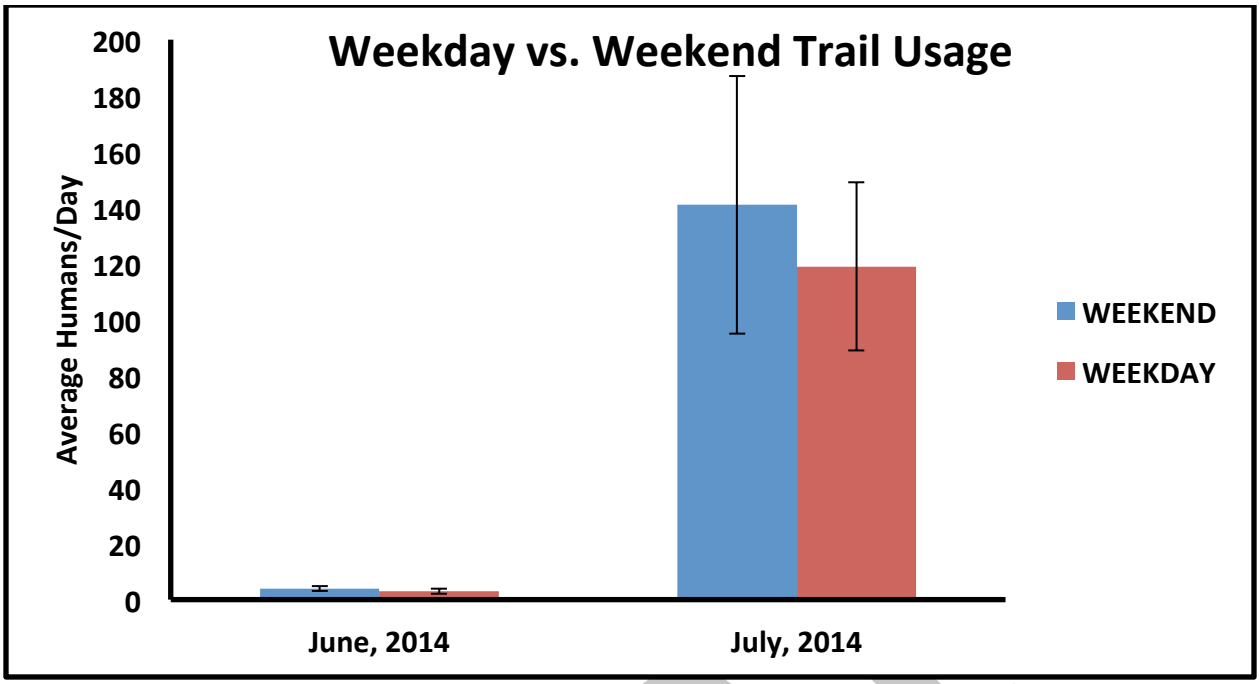


Figure 5.4 There was no statistical difference in the average number of humans per weekend day compared to the average number of humans per weekday ($p > 0.05$).

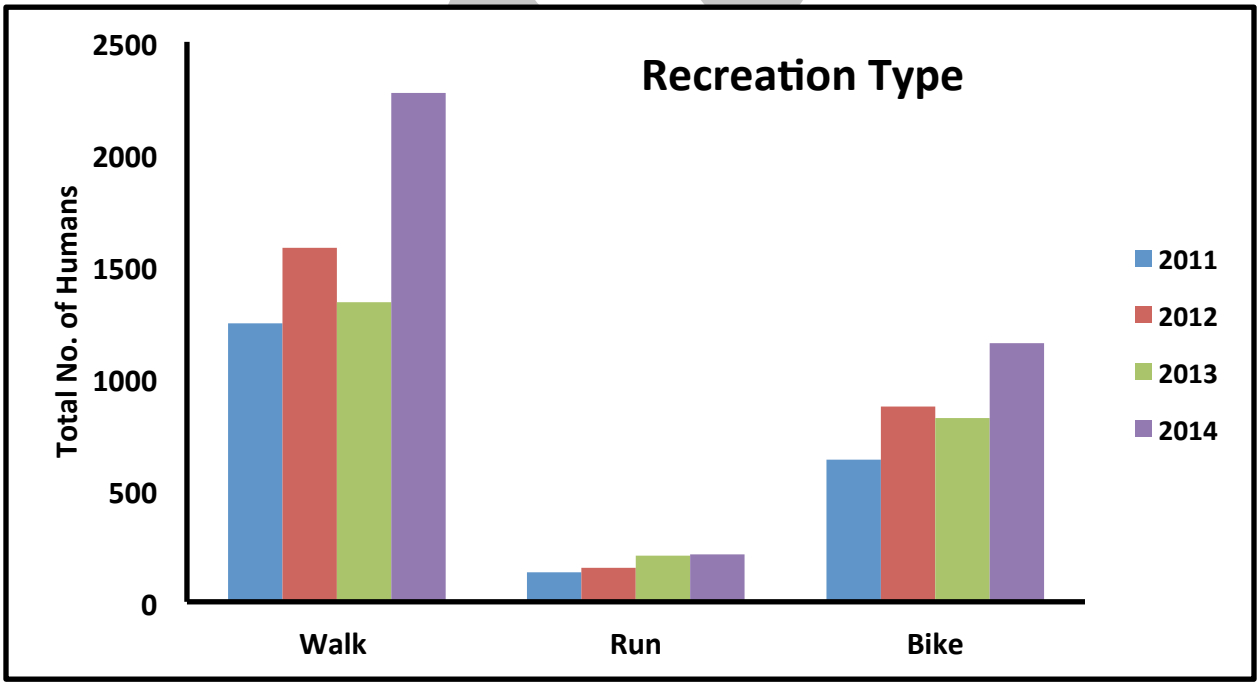


Figure 5.5 The type of recreation observed on a recreation trail for 2011 through 2014.

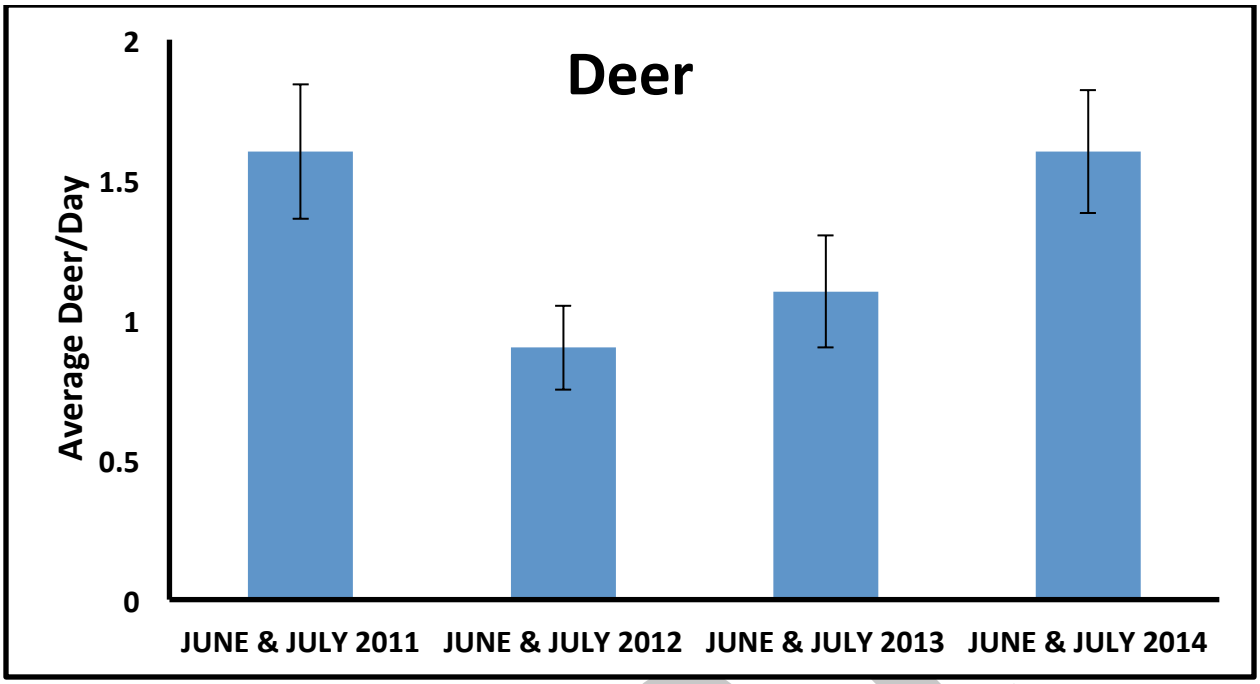


Figure 5.6 The average number of deer per day was not significantly different from June and July 2013 ($\overline{X}$=1.07 $\pm$ 0.2) to June and July 2014 ($\overline{X}$ = 1.6 ±0.2; p=0.5).

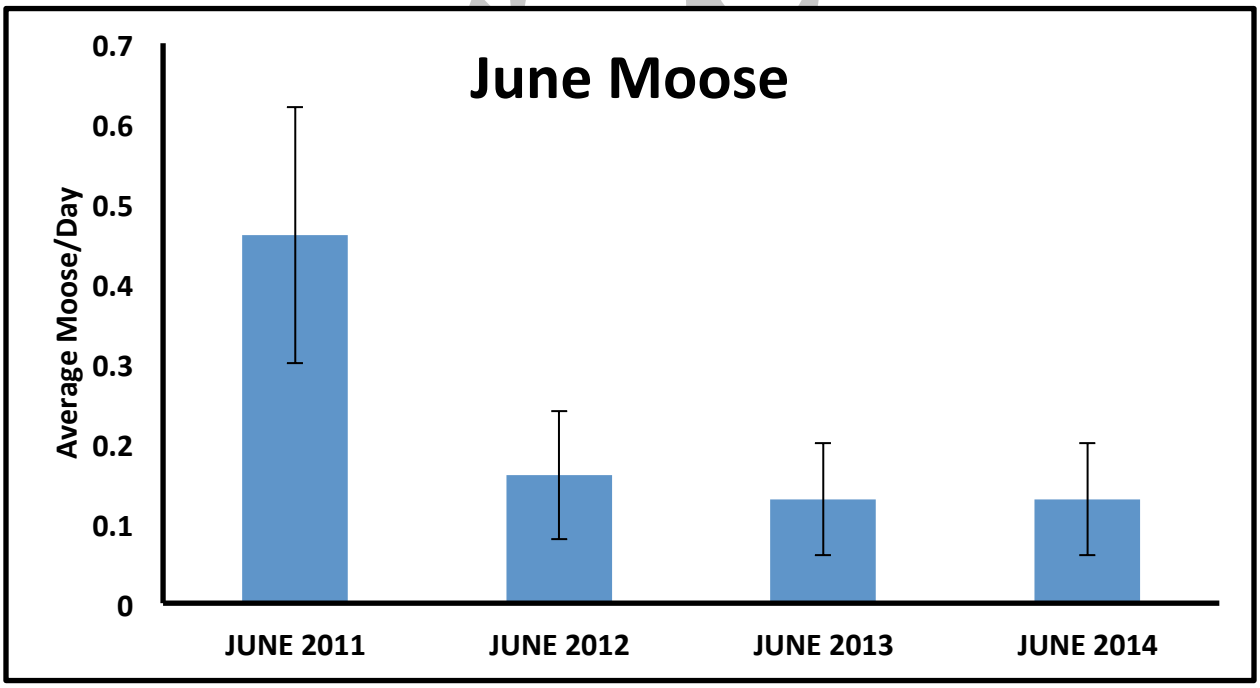


Figure 5.7 The average number of moose per day was not significantly different when comparing June 2013 ($\overline{X}$ =0.13±0.07) to June 2014($\overline{X}$= 0.13±0.07, p = 1).

Photo 5.1 Three moose (*Alces alces*) photographed on June 14th at 7:13pm.

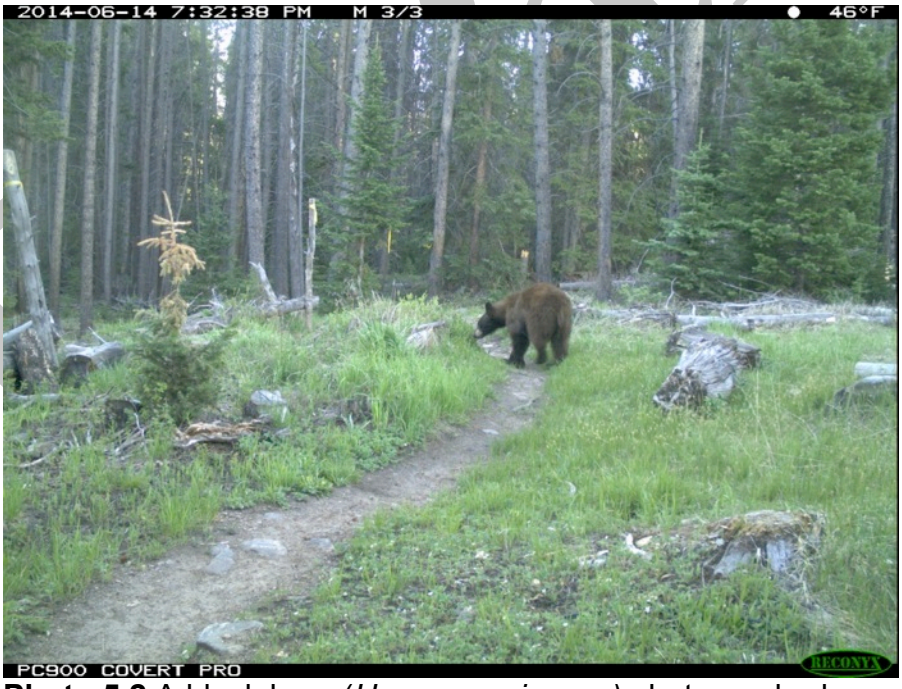


Photo 5.2 A black bear (*Ursus americanus)* photographed on June 14th at 7:32pm.

Photo 5.3 A snowshoe hare (*Lepus americanus*) photographed (to right of the trail) on June 11th at 1:09am.

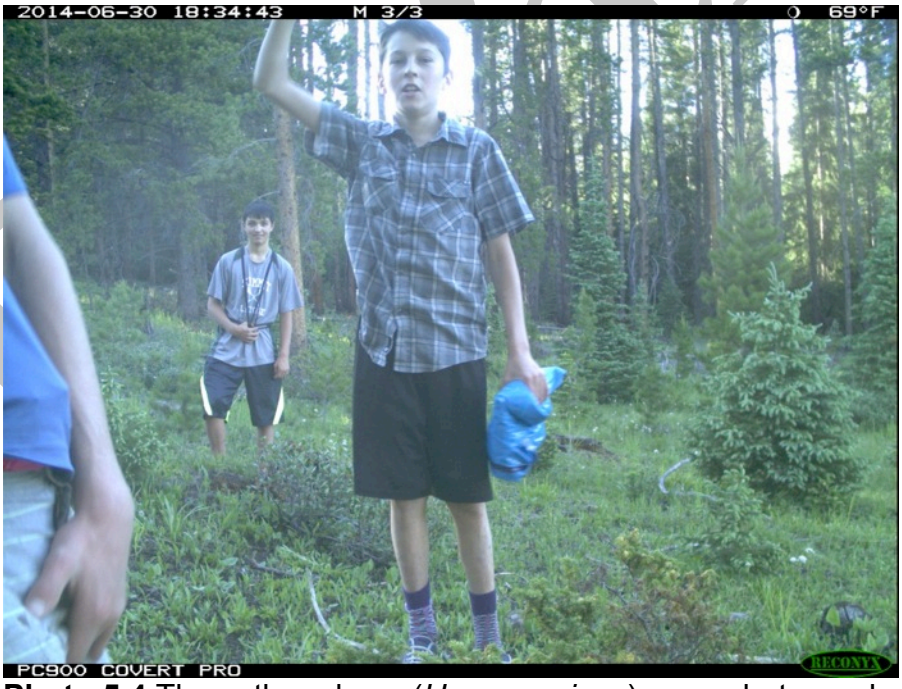


Photo 5.4 These three boys (*Homo sapiens*) were photographed on the gondola cut June 30th at 6:34pm when the Gulch is officially closed to visitors. Many people mistake the cut for hiking trail as there are no signs to the contrary.

Photo 5.5 This mountain biking family of five and their off leash dog were photographed July 19th at 11:53am.

6.0 DOCENT PROGRAM 2014

6. 1 Introduction & Methods

As reported in chapter five, Cucumber Gulch is widely used throughout the summer months for recreation such as hiking, trail running and biking. While most visitors tend to stay on the trail and leave their dogs at home there continues to be many who do not understand the reasoning behind these management decisions. In addition, many 2013 visitors did not realize the diversity of wildlife present or the importance of protecting wetlands. The trails in Cucumber Gulch are typically closed from June 1 until the Monday following the 4th of July holiday weekend. This time of year is a sensitive period for wildlife reproduction and an ideal time to keep disturbance to a minimum.

For the second summer, a docent was stationed on select days at the Cucumber Gulch trailhead on Ski Hill Road directly across the road from the Peaks trailhead (Photo 1). The acting docents in 2014 were Elizabeth Kelso and Cole Archer. During the trail closure, at least one docent was in attendance from June 25-29 and again on July 3-6 from approximately 9am to 3pm. A docent was also in attendance on Monday July 7 from 9am-3pm, the first day the Gulch trails were open for the summer.

The docent's job was to educate visitors about the ecological factors, such as moose calving and bird nesting, which prompt wildlife managers to close the trails each year. An educational information board was on display at the trailhead that featured a wide variety of the species captured on the motion sensor cameras and emphasized the importance of protecting wetland ecosystems.

6. 2 Results

Trails Closed

From June 25-29, the docent spoke with an average of 12 people per day. Of those people, 60% were intending to use the trails but decided not to after speaking with the docent. Two percent of the visitors spoken with were locals who ignored the trail closure, lifted their mountain bikes over the fence and proceeded down the trail despite the presence of the docents. The other 38% were curious when they saw the docent setup from the Peaks trailhead and came over to investigate.

From July 3-6, the docent spoke with an average of 16 people per day. Of those people, 74% were intending to use the closed trails but decided not to after speaking with the docent. The other 26% were curious when they saw the docent setup from the Peaks trailhead and came over to investigate.

Over the nine day period, only six people were seen exiting the Gulch. Two of which seemed genuinely clueless and were surprised to be told they were on a closed trail.

The other four were happy to tell us they lived locally and always ignored the seasonal closure as they believed it was their right to use the area as they pleased.

Of the total people who approached the docents at the trail head during the nine day closed trail period, 78 of them were visiting from out-of-state and 170 lived in Colorado.

When comparing 4th of July Gulch traffic in 2013 to 2014 there was a significant decrease in visitor volume overall in 2014 (Figure 1). When comparing only the hours when the docent was present there was a significant reduction in visitors on Friday and Saturday but no difference when comparing Sundays (Figure 2).

Trails Open
On July 7th a docent was present at the trailhead from 9am-3pm and positively interacted with 49 visitors overall.

6.3 Discussion

The majority of visitors were supportive and excited to hear about the wetland and its inhabitants. Many visitors did not know anything about the ecology and value of a wetland and when viewing the displayed photographs, were shocked at the species diversity present in Cucumber. Very few visitors ignored the trail closure once interacting with the docent. Of the 248 people spoken with during the trail closure period, only eight of the visitors expressed genuine unhappiness at being denied access to the Gulch. Of those eight only four mountain bikers decided to use the trail despite the trial closure. Due to improved trail closure barricades there were barely any visitors exiting the gulch via the Ski Hill Rd trailhead in 2014. The information board featuring the motion sensor camera photos delighted visitors of all ages and was immensely useful for impressing people with the diversity of species utilizing the habitat year round.

On numerous occasions in 2014 the docent was told by visitors that their hotel concierge informed them that Cucumber was open all year round and to ignore the trail closure signs. Another group was told the same thing by a gondola operator. In 2015 the docent's duties should be expanded to include educational visits to the various resort concierges and the gondola operators with the intention of gaining their understanding and respect of the trail closures. The town website should continue to include the trail closure dates on the Cucumber Gulch pages including an explanation of the wildlife management prompting the closure. It would be wonderful to improve the signage to include closure dates (not just opening day) and a well worded message about moose calving and bird nesting season. The docents found that sharing this information stopped most visitors in their tracks and having these details available 24/7 will help people to better understand and respect the closure even when the docent is not present.

Overall, awareness about Cucumber Gulch was successfully raised over a period of 60 total hours at the trailhead. Tourists and locals alike were pleased to see the camera capture photos on display and eager to stop and chat about the wetland. It is

recommended that we continue to expand on the total hours a docent is present when the trails are closed to include all of June. When the trails are open in July and August it would be beneficial to organize volunteer trail docents. Volunteer docents could spend their time educating people while moving about the Gulch and/or stationed at one of the interpretive signs. This would allow us to establish a helpful presence while encouraging visitors to stay on trails and respect wildlife.

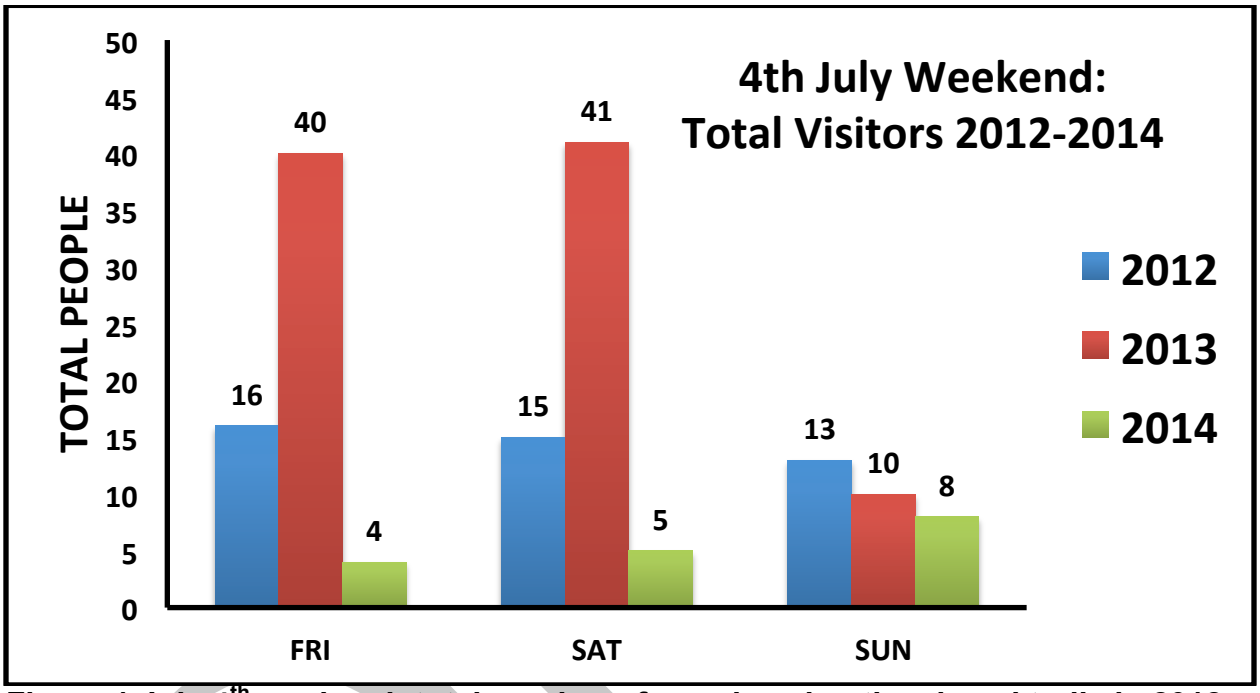


Figure 1 July 4th weekend; total number of people using the closed trails in 2012, 2013 and 2014. The trail use data was compiled from the recreation trail camera which is in place annually from July through August (chapter 5).

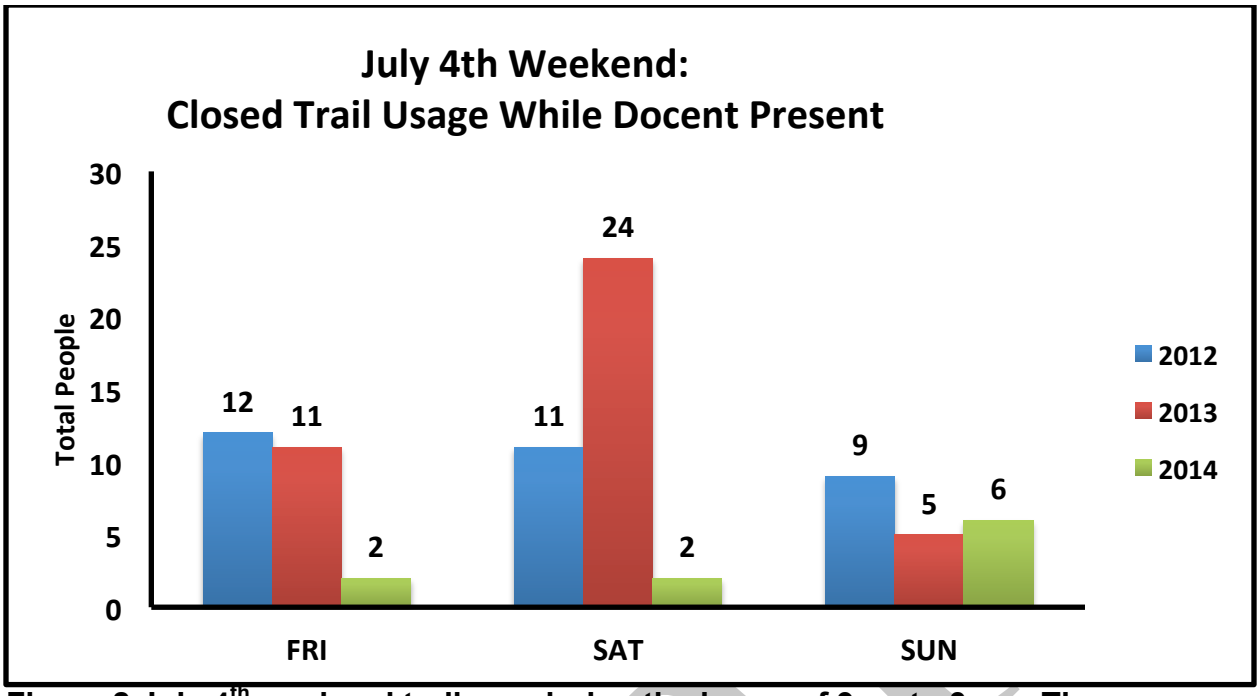


Figure 2 July 4th weekend trail use during the hours of 9am to 3pm. There was no docent present in 2012. There was a docent present in 2013 for 30 total hours and in 2014 for 60 total hours. The trail use data was compiled from the recreation trail camera which is in place annually from July through August (chapter 5).

Photo 1 The docent setup located at the Cucumber Gulch trailhead on Ski Hill Rd across from the Peaks trailhead. The educational information boards are hanging from the fence.

7.0 HABITAT COMPARISON OF VEGETATION

7.1 Vegetation Background

Four distinct habitat types have been identified within established macroplots by SAIC in Cucumber Gulch in 2001. These habitats include lodgepole pine forests, mixed conifer forests, shrub-wetland habitats and a combination of mixed conifer and shrub-wetland habitats. Due to re-routing of a summer trail and the Peak 7 ski area base development we have lost two monitoring macroplots in two habitat types: the mixed conifer/shrub-wetland habitat and the lodgepole pine forest habitat. The following study compares canopy cover, species richness, species evenness and species diversity in the remaining mixed conifer and shrubland maroplots.

Lodgepole pine forests are dominated by lodgepole pines (*Pinus contorta*). These trees are the only trees found in this habitat. The trees in this habitat are mostly uniform in height because of the intense competition for light. Lodgepole Pines rely on fire (temperatures of 113°F -122°F) for seed germination. Fire is required to melt the resin between the scales of the cone. Also, strong winds can open the cones (Mutel and Emerick 1992). In addition, some cones in lodgepole pine stands will be produced with less resin and are available for germination without fire. Thus, lodgepole pine forests represent a previously disturbed habitat and are successional to Subalpine Fir (*Abies bifolia*) and Englemann Spruce (*Picea engalmanni*) in Breckenridge, Colorado. Understory vegetation in lodgepole pine forests is sparse or absent due to minimal light penetration to the forest floor. This habitat type is represented in previous reports, but no longer exists in the survey area due to development activities along Ski Hill Road.

Mixed conifer habitats are dominated by Subalpine Fir (*Abies bifolia*), Englemann Spruce (*Picea engalmanni*), and Lodgepole Pines (*Pinus contorta*). This habitat is common along the edges of wetlands and is often found between lodgepole pine forests and shrublands in Cucumber Gulch. The presence of Lodgepole Pines reveals a previous disturbance to the area 50-100 years ago. Fir seedlings are more successful at establishment in the shade of spruce and lodgepole but have a lower survival rate. Spruce trees are less susceptible to disease and are longer lived (Mutel and Emerick 1992). Thus, mature spruce trees are slightly more abundant than mature fir. Spruce and fir can reproduce by layering (seedling sprout from roots). Both spruce and fir grow very slowly. It has been reported that spruce require 10 years for every foot in height (Mutel and Emerick 1992). The forest floor in this habitat is littered with rotting logs. Understory vascular plants tend to be shade and moisture loving (Benedict 1991) and are found in patchy distribution patterns.

7.2 Vegetation Methods

Original methods for vegetation sampling were established by SAIC and outlined in the April 27, 2001 Conservation Monitoring Plan (CMP), Cucumber Gulch (SAIC 2001).Data for years 2001 and 2002 were collected by a single SAIC staff member and is dramatically different from the consistent evaluation that has occurred by Dr. Christy Carello (Metropolitan State University of Denver) and Dr. Catherine Kleier (Regis University) where they have implemented a consistent program of species identification and a two person protocol for evaluating percent cover. The data in this report represents data collected starting in 2003.

Vegetation sampling occurred during the last week of July 2014. Estimates of percent cover of each species of vegetation and overall vegetation cover were made for all sampling quadrats at each macroplot (Table 7.1, Map 7.1). Considerable time was devoted to accurate species identification. Estimates were always made by at least two individuals in the field and then these estimates were averaged to get the most accurate results (this is a modification from SAIC's original methods that was implemented in 2003 where only one scientist identified species and estimated vegetation cover).

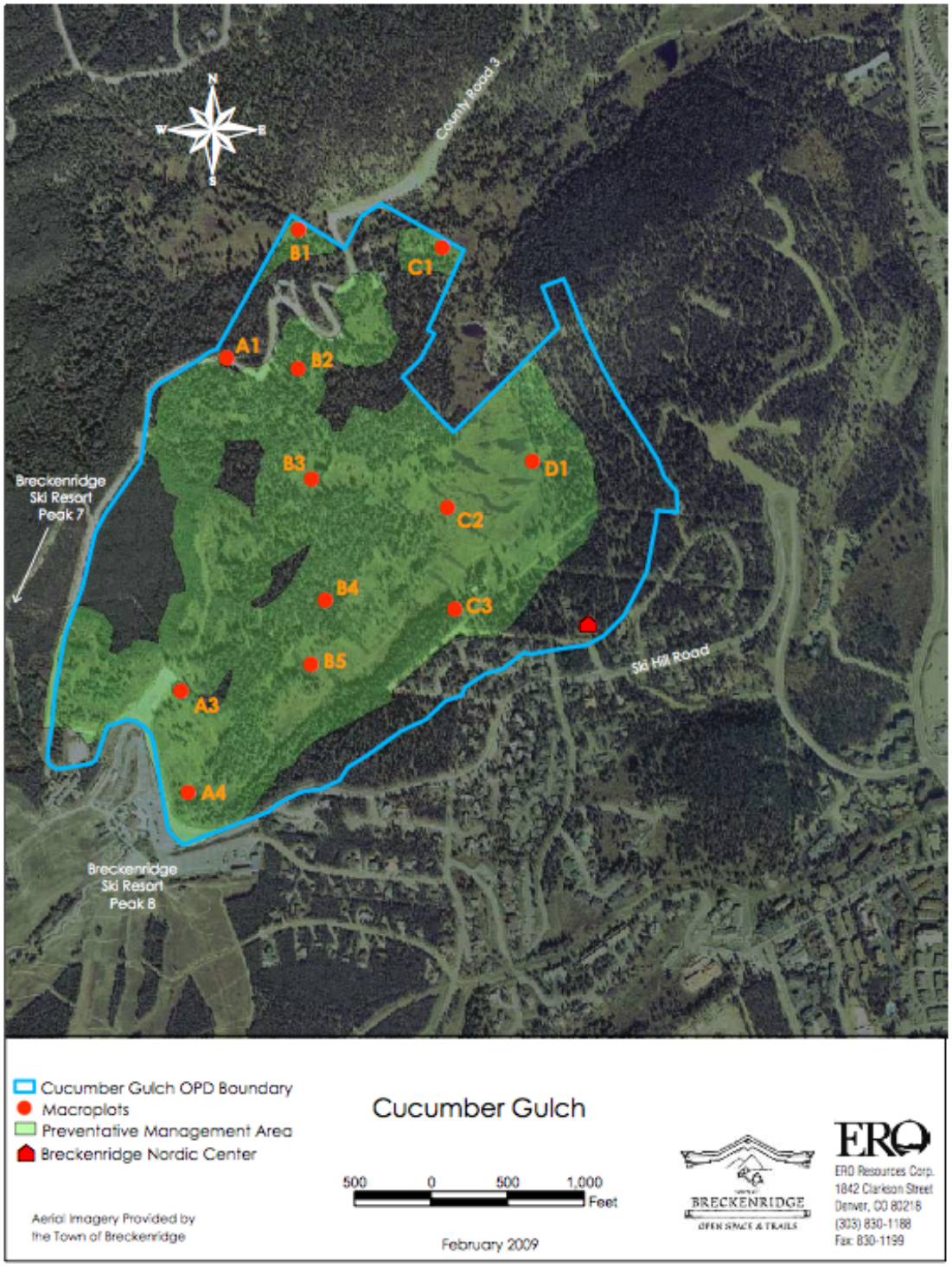
Species richness and canopy cover were determined from estimations of percent cover. In addition, the Simpson's index was used to determine overall species diversity and evenness of vegetation in the four habitat types in Cucumber Gulch.

One new sampling location was established in 2014 that was designated A3.5. The reason for this designation is based on its location between Macroplot 3 and 4 on the A transect. This plot was established because it is in the top portion of the Gulch, just below Ski Hill Road, an area that has experienced altered hydrology and is in close proximity to areas of human habitat alteration. This area was also a test site for chemical treatment in **2010????**.

Single factor Analysis of Variance statistics were used to determine statistically significant differences between means. A standard probability value of 0.05 was used to determine significance, meaning that there is less than a 5% chance that the statistical differences are a result of error.

Table 7.1. GPS coordinates and habitat typing for vegetation sampling in Cucumber Gulch, Breckenridge, Colorado.

Macroplot	Habitat Type	North	West
A1	Mixed Conifer	39°29.36'	106°03.91'
A3	Mixed Conifer	39°29.00'	106°03.97'
A4	Shrub	39°28.89'	106°03.96'
B1	Shrub	39°29.50'	106°03.81'
B2	Mixed Conifer	39°29.35'	106°03.81'
B3	Shrub	39°29.23'	106°03.79'
B4	Mixed Conifer	39°29.10'	106°03.77'
B5	Shrub	39°29.03'	106°03.79'
C1	Shrub	39°29.48'	106°03.61'
C2	Shrub	39°29.20'	106°03.60'
C3	Mixed Conifer	39°29.09'	106°03.59'
D1	Shrub	39°29.25'	106°03.48'
A3.5	Shrub		



Map 7.1. Cucumber Gulch Map illustrating vegetation macroplots.

7.3 Vegetation Results and Conclusions

Vegetation monitoring was conducted at five mixed conifer sites and seven shrubland sites (five of the seven are considered wetland habitat). Two other sites (B6 and A2) that each represented a specific habitat type (mixed conifer/shrubland and lodgepole pine forest) have been eliminated due to trail development in 2005 and the Peak 7 lodge development in 2006. Results in the figures are presented for years 2003-2011 and 2014 for mixed conifer and shrubland habitat only. The data is analyzed for comparisons between years and habitat types. Photographs of macroplots are in Appendix I.

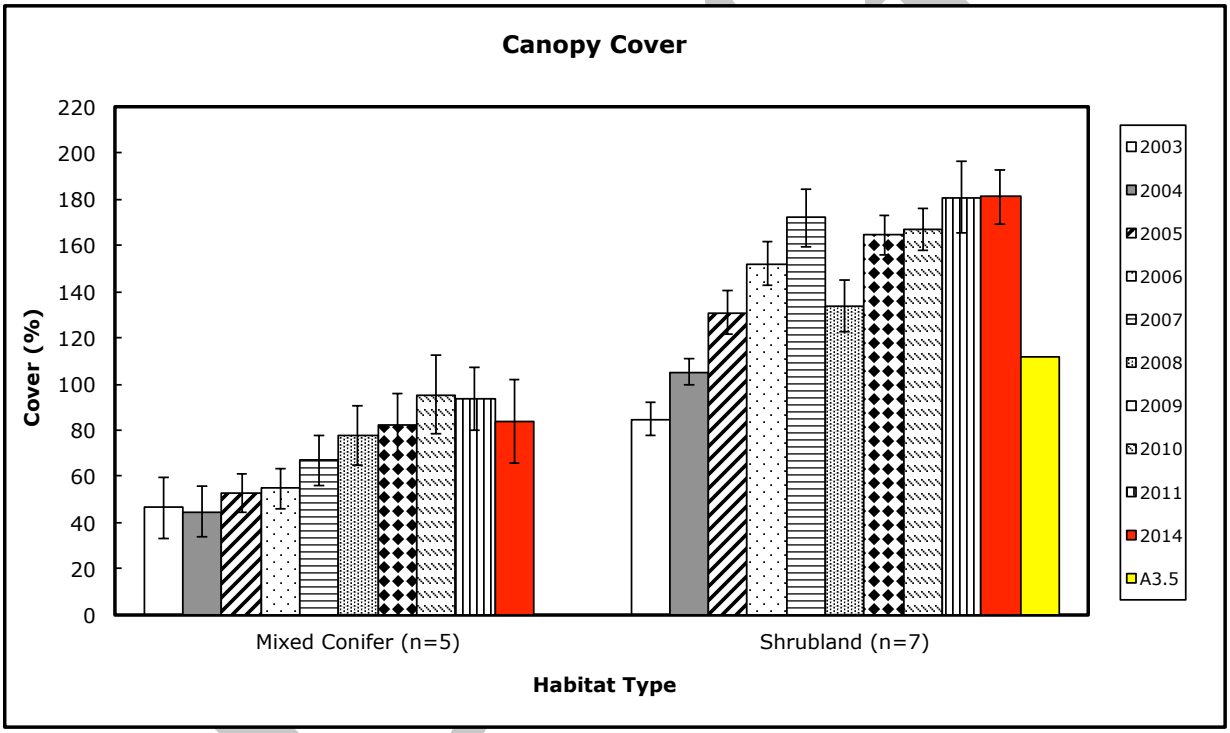


Figure 7.1. A comparison of 2003-2011 and 2014 canopy cover in Cucumber Gulch, Breckenridge, Colorado.

Canopy Cover

Canopy cover is an estimate of the percentage contribution of each species in each macroplot. No significant change in canopy cover for the mixed conifer habitat was observed in 2014 when compared to 2011 (Figure 7.1). However, regression analysis does reveal a continued increase in overall canopy cover between the years of 2003 and 2011. This steady increase in mixed conifer habitat may have been due to an increase in sunlight penetration to the forest floor as lodgepole pine trees have died due to the pine beetle epidemic.

Canopy cover in shrubland habitats is significantly greater than in mixed conifer habitats (Figure 7.1). Overall, there has been a significant increase in canopy cover in the shrubland habitat between 2001 and 2007 (Analysis of variance: F = 14.41, p = $1.12x10^{-6}$). Precipitation in 2005, 2006, and 2007 was above the average annual precipitation of 19.78 inches. The increased canopy cover in shrubland vegetation observed between 2001 and 2007 was likely a result of an increase in total annual precipitation. There was a significant decrease in canopy cover of shrubland vegetation between 2007 and 2008 (Student t-test: t = 2.18, p = 0.044). This decrease is because of significant change to one of the sampling locations (A4) in this habitat type related to severe habitat augmentation (large scale tree removal to increase the size of the nearby retention pond). There was no change in shrubland canopy cover between 2011 and 2014 (Student t-test: t = 2.17, p = 0.44). Canopy cover at the new sampling location (A3.5) was much lower that at other shrubland locations. This is likely because of its location is in a drier and more disturbed portion of the Gulch. It should also be mentioned that approximately 50% of the cover was composed of weedy species (please see next section on weeds).

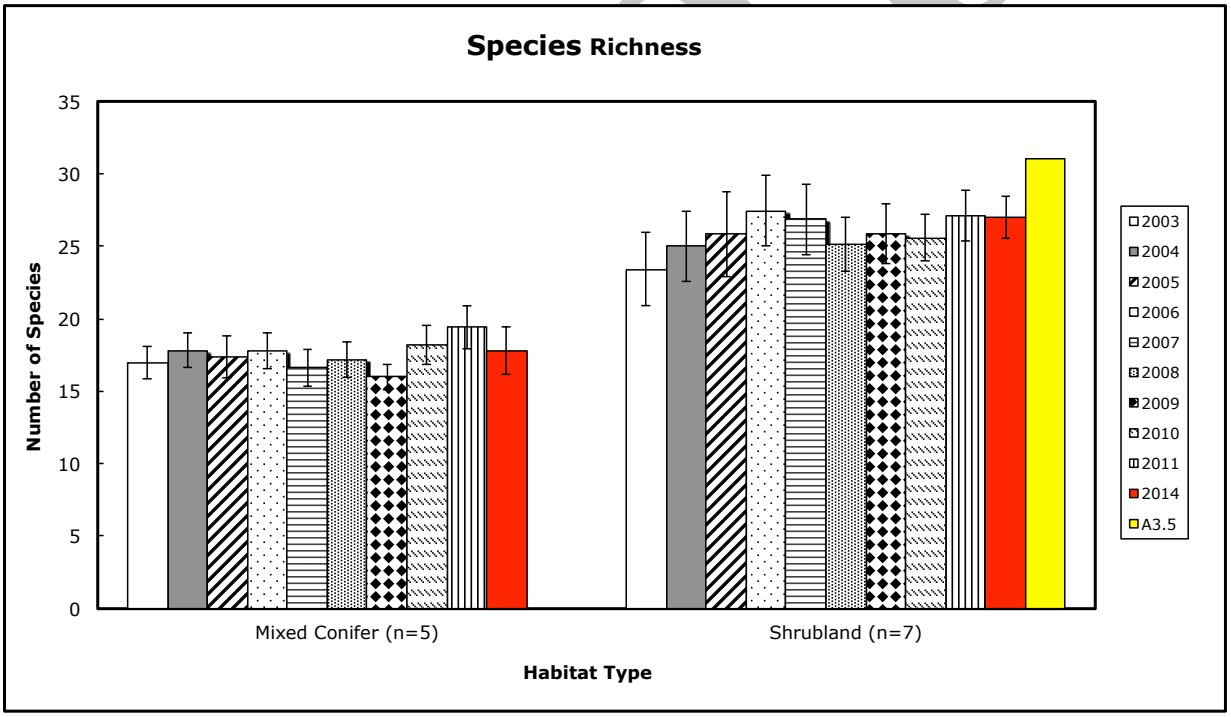


Figure 7.3. A comparison of 2003-2011 and 2014 understory vascular plant species richness in Cucumber Gulch, Breckenridge, Colorado.

Species Richness

Overall there are significant differences in understory vascular plant species richness between habitat types (Student t-test: t = 2.14, p < 0.001). Shrubland habitat contains significantly greater species richness than mixed conifer. There was no significant

difference in species richness in either habitat type in 2014 (Student t-test: t = 2.14, p < 0.001). The new sampling site (A3.5) had noticeably more species than the other locations. Most of these species were only found at this location and many of the species are weedy (discussed more in the next section).

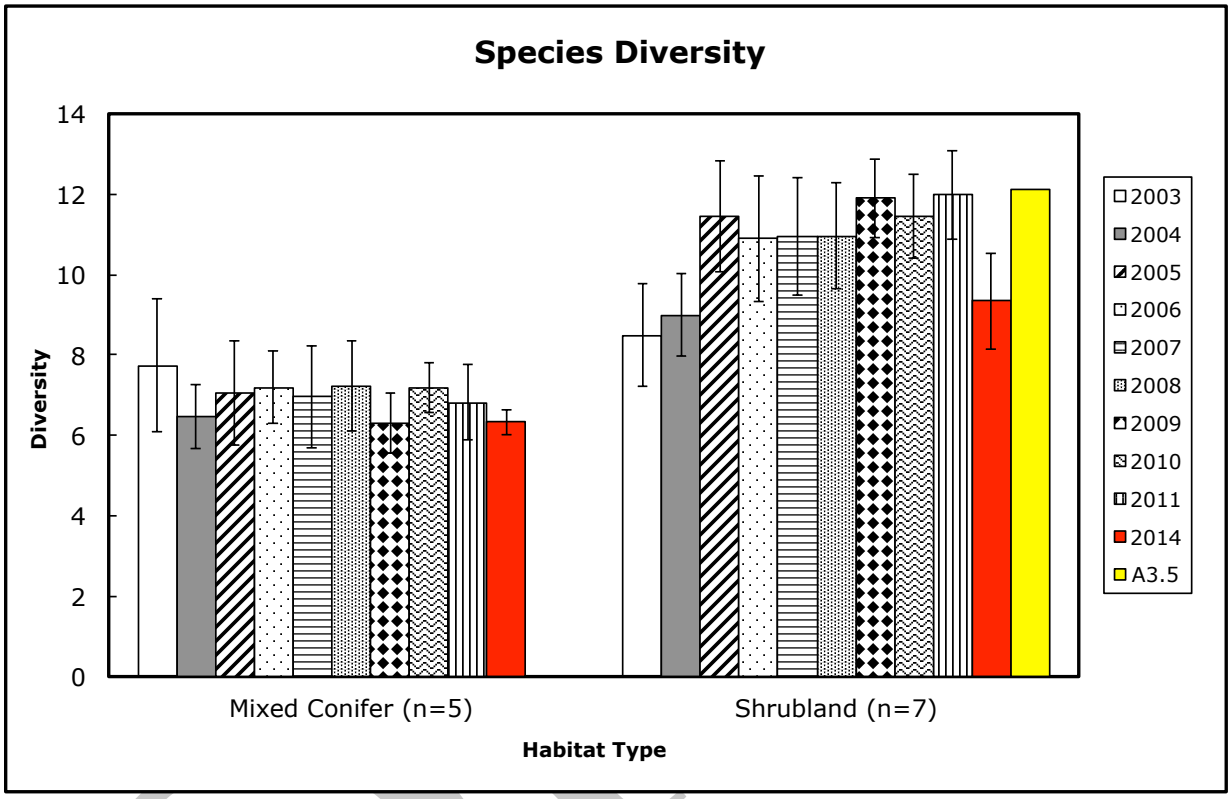


Figure 7.4. A comparison of 2003-2011 and 2014 understory vascular plant species diversity in Cucumber Gulch, Breckenridge, Colorado.

Species Richness

Species diversity is calculated from the proportion of each species in the total sample of individuals (Ricklefs 2001). This index allows us to compare different habitat types for diversity even when overall numbers of individuals are significantly different. For example, there are clearly more individual plants located in shrubland habitat than in mixed conifer habitat (Figure 7.4). The Simpson's Index for diversity takes this difference into account and gives us a standard for comparison.

Overall, shrubland habitat is higher in species diversity than mixed conifer habitat (Student t-test: t = 2.14, p < 0.001). The differences in species diversity between habitat types is likely a result of natural differences expected at this elevation in the two different habitat types. There was no significant difference in diversity in mixed conifer habitat between 2011 and 2014 (Student t-test: t = , p =). However there was a significant decline in diversity in shrubland habitat in 2014 when compared to 2011 (Student t-test: t = 2.64, p = 0.018). This decrease in diversity is mainly a result of a sharp decline in diversity at site D1 that is located in close proximity to Josie's Cabin.

Reed canarygrass was found at this site for the first time and may have contributed to the decrease in diversity.

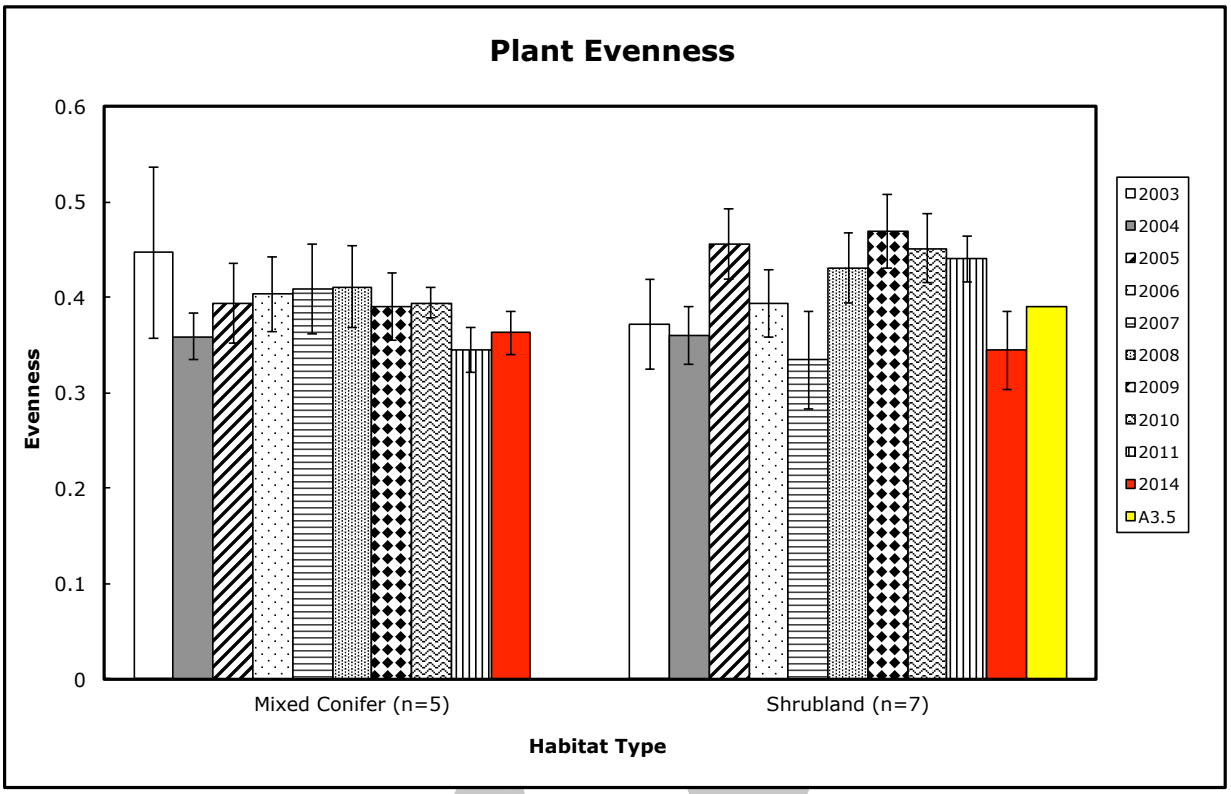


Figure 7.5. A comparison of 2003-2011 and 2014 understory plant species evenness in Cucumber Gulch, Breckenridge, Colorado.

Evenness is the relative abundance of individuals among the species (Smith and Smith 2001). Thus, the more equitable the distribution of species is, the greater the evenness. Evenness is calculated by dividing species diversity by species richness. Habitats with greater evenness have fewer dominant species.

Overall there has been no difference in evenness between mixed conifer habitats and shrubland habitats (Student t-test: t = 2.14, p = 0.71). The average value for evenness is 0.40 for both habitat types, meaning that there are a few plants in each habitat type that are dominant. There was an apparent drop in evenness in mixed conifer habitat between 2010 and 2011 was not significant (t=2.31, p=0.13), and there was not significant difference in evenness in mixed conifer in 2014.

There was a significant decrease in evenness in shrubland habitat in 2014 from 2011. Meaning that a few species are dominant in this habitat type. Again D1 which is dominated by *Calamagrostis Canadensis, Salix planifolia,* and *Carex aquatilis substantially* contributed to this decline.

7.4 Vegetation Summary and Recommendations

Overall 135 plant species have been identified in Cucumber Gulch (Table 2.3). The shrubland habitat provides the greatest amount of vegetation for herbivores than any other habitat type. The decline in diversity and evenness should be evaluated following the next vegetation survey to insure this is not a trend and just an anomaly that occurred in 2014.

8.0 Weeds in Cucumber Gulch

8.1 Weeds Background

Weeds are non-native plants that were intentionally or accidentally introduced to an area. Weeds are often categorized as invasive and/or noxious. Invasive weeds are aggressive non-native plants whereas noxious weeds are not only invasive but are also highly destructive to agriculture, human health and/or the environment. Title 35, Article 5.5 of the Colorado Noxious Weed Act refers to noxious weeds as plants that have a direct or indirect detrimental effect to the environmentally sound management of natural ecosystems. Noxious weeds impact the natural integrity of the environment by robbing native plants of precious water, nutrients and sunlight. Because of their highly competitive nature and lack of natural predators they rob animals of their food sources, nesting areas, access to water, and habitat used for protection from predators. They also reduce ecological diversity. Noxious weeds seem to thrive in areas of disturbance from construction, travel and recreation. Colorado has 1,300 native plants of which 130 or 10% have been displaced by non-native weeds (Colorado Weed Management Association).

8.2 Weeds Methods

All macroplot results were examined for non-native, invasive and noxious weeds from plant surveys conducted in 2004-2011 and 2014. In addition, specific areas outside of the designated macroplots were evaluated for the presence of noxious weeds on June 16 and August 1, 2014.

8.3 Weeds Results Macroplots

The results from the 2003-2011 and 2014 vegetation surveys of weeds in macroplots are presented in Table 8.1. There was an overall increase in weedy species in the established macroplots in 2014. The biggest increases were in clover (*Trifolium hybridum*) at A4 (just below the base of Peak 8) and common dandelion (*Taraxacum officianale*) at C1 (adjacent to new home construction off of Ski Hill Road on the north side of the Gulch). The most concerning weeds found in macroplots in 2014 were scentless chamomile (*Anthemis arvensis*) and reed canarygrass (*Phalaris arundinacea*) at A4 and D1 (near Josie's Cabin) respectively. These weeds had not been identified in established macroplots prior to the 2014 vegetation survey. In addition, weedy species represented close to 50% of the percent cover at the newly established macroplot A3.5 (Table 8.2, total canopy cover was estimated at 112% with weedy species making up 62% of the cover). Most alarming was the high percentage of scentless chamomile (*Anthemis arvensis*) and yellow toadflax (*Linaraia vulgaris*) at this location. Figure 8.1 depicts an increasing trend in the percent cover of weedy species in macroplots in Cucumber Gulch and warrants continued monitoring.

Table 8.1. The percentage of weeds as a function of canopy cover in macroplots during the 2003-2011 and 2014 vegetation surveys in Cucumber Gulch, Breckenridge, Colorado.

Macroplot	Habitat	Species	Common Name	Weed Designation	% Cover 2003	% Cover 2004	% Cover 2005	% Cover 2006	% Cover 2007	% Cover 2008	% Cover 2009	% Cover 2010	% Cover 2011	% Cover 2014
A3	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	2.45	0.4	1.2	3.6	2.02	2.25	0.96	1.41	4.33	3.4
A4	Shrub	*Anthemis arvensis**	Scentless Chamomile	Noxious	0	0	0	0	0	0	0	0	0	0.2
A4	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	2.6	.87	2.6	3.5	2.27	1.49	1.36	0.92	2.12	2.4
A4	Shrub	*Trifolium hybridum*	Clover	Non-native	1.3	0	0	0	.45	0	0.12	0.61	0.53	7.4
A4	Shrub	*Phleum pratense*	Field Timothy	Non-native	0	0	.131	0.52	0	0	0.37	1.23	0	0
B1	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	0.55	0.2	.29	1.03	1.44	.6	0	1.45	2.18	0.6
B3	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	1.61	1.5	.5	2.19	1.6	1.7	1.45	0.78	0.41	1
B3	Shrub	*Phleum pratense*	Field Timothy	Non-native	2.5	0	0	0	0	0	0	0	0	0
B4	Mixed Conifer	*Cirsium sp.*	Canada Thistle	Non-native	0.92	.95	1.6	2.22	1.36	1.09	0.37	1.38	1.93	0.4
B5	Shrub	*Anthemis arvensis*	Scentless Chamomile	Noxious	0	0	0	0	0	0	0	0	0	0.6
B5	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	0.43	0.8	.49	.32	.39	0	0	0.10	0.97	0
C1	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	0	0.2	.59	2.7	0	1.22	4.0	4.21	3.94	8
C1	Shrub	*Cirsium sp.*	Canada Thistle	Non-native	1.89	1.96	0	0	0	0	0	0	0.33	2
C2	Shrub	*Taraxacum officianale*	Common Dandelion	Non-native	0	0.2	0	0	0	0	0	0	0.22	0
C3	Mixed Conifer	*Taraxacum officianale*	Common Dandelion	Non-native	1.5	0.6	1.05	.97	0	1.24	0.73	0.19	0.18	0.6
C3	Mixed Conifer	*Cirsium sp.*	Canada Thistle	Non-native	0.38	1	0.35	0.97	0.52	0.83	0.37	0.56	0.53	0
D1	Shrub	*Phalaris arundinacea*	Reed Canarygrass	Native*										4

**Can be invasive in wetland systems*

Table 8.1. The percentage of weeds as a function of canopy cover in in the newly established macroplot 3.5 from the 2014 vegetation surveys in Cucumber Gulch, Breckenridge, Colorado.

Species	Common Name	Weed Designation	Percent of Canopy Cover
Anthemis arvensis	scentless chamomile	Noxious	6.6
Chenopodiun berlandieri	lambsquarters	Noxious	2
Cirsium arvense	Canada thistle	Non-native	13
Descurainia sophia	flixweed - mustard	Non-native	2
Linaraia vulgaris	yellow toadlax	Non-native/Invasive	6.8
Phleum pratense	field timothy	Non-native	12
Polygonum erectum	erect knotweed	unsure	1.4
Tanacetum vulgare	common tansy mustard	Noxious/non-native	0.4
Taraxacum officianale	common dandelion	Non-native	1.2
Total			**62**

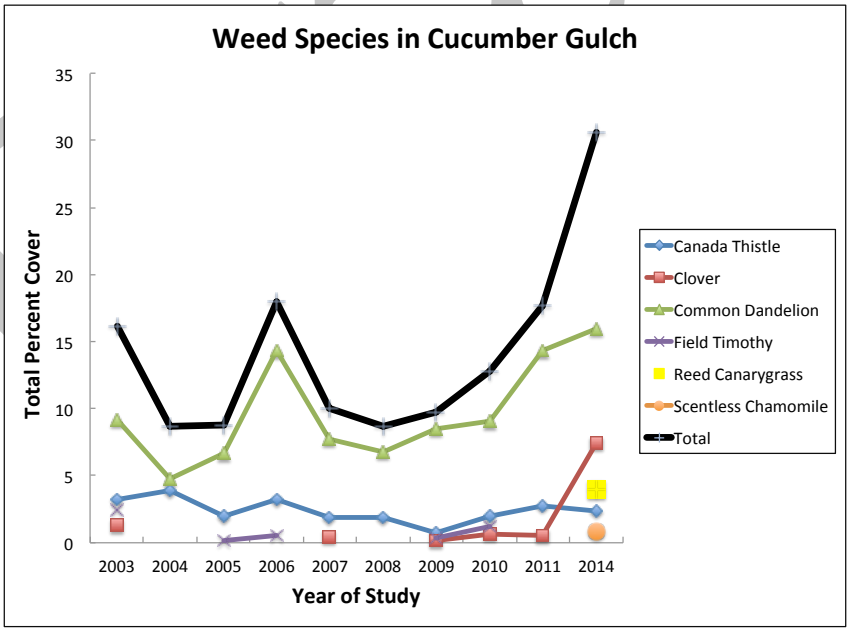


Figure 8.1. Change in percent cover of weedy species in Cucumber Gulch 2003-2011 and 2014.

8.4 Weeds Survey Results

The following are the two weed reports submitted the Town of Breckenridge in June and August of 2014.

16 June 2014
Weed evaluation for Cucumber Gulch
Conducted by: Christy Carello, PhD

Evaluation for weeds occurred at Ski Hill Road below Peak 8, near the bridge at Peak 7, Gold Digger trail, Practice trail and Jose's Cabin. The only problematic location is the area below Ski Hill Road at Peak 8. Canada thistle and dandelions are prevalent in this area. There are also very small chamomile plants, especially in the erosion mat along the detention pond. In addition, there are numerous *Barbarea vulgaris* (pictured below), also called bittercress and garden yellow rocket in the erosion mat, but also along the banks of the restored ponds. This is a flowering plant with clusters of small yellow flowers with four petals. This plant is native to Eurasia and is considered a weed in North America. Finally there were very small False Chamomile plants on the Practice Trail.

1 August 2014

Weed evaluation for Cucumber Gulch
Conducted by: Christy Carello, PhD

Below Ski Hill road at Peak 8

Hillside below Ski Hill Road has improved. However, these weeds were identified on the hillside and in the wetland system just below the hillside;

Scentless chamomile, Lambsquarters, Canada thistle, flixweed, Yellow toadflax, erect knotweed, common tansy mustard, dandelion.

Josie's Cabin

Area around cabin has improved: Scentless chamomile, Dandelion, red clover, squirreltail grass

Along Ski Hill road from Peak 8 to Peak 7
Yellow sweetclover, Canada thistle

Pocket in Main wetland system under gondola
Canada thistle, Scentless chamomile

Practice Loop
Coast tarweed

Recommendations
1. Extensively weed Peak 8 hillside and in wetland system below hill on North side
2. Remove thistle and chamomile by hand in main wetland system under gondola.
3. Remove Coast Tarweed on practice loop (this is a late species and will likely go to seed near end of September)

8.5 Weeds Conclusions

Weeds continue to threaten the biological integrity of Cucumber Gulch. It is alarming that more weeds were found in macroplots in 2014 than in any previous sampling period. Most concerning was the presence of scentless chamomile at B5 which is in the interior portion of the wetland complex. Also the identification of both scentless chamomile and yellow toadflax on the boundary hillside at Peak 8 and in the newly established macroplot could likely result in a major invasion if not addressed. Finally, the substantial patch of Canada thistle in the main wetland complex under the gondola could become problematic, especially if water is re-channeled or is less available in 2015.

9.0 PHOTOGRAPHIC DOCUMENTATION

Digital photographs were taken at specific locations in Cucumber Gulch in May, August and December of 2014. The photos should be used as a reference of change and can be compared to photos in the Visitors Experience and Resource Protection Plan (VERP) in Cucumber Gulch, Breckenridge, CO, 2009 and the Cucumber Gulch Monitoring Report for 2009 - 2012. The following locations were photographed from multiple view points on all photo dates: Shock Hill Overlook, Geology Interpretive Sign, Ungulate Interpretive Sign, Avian Interpretive Sign, Beaver Interpretive Sign, Ski Hill Road at Peak 8 and the bridge at Peak 7. Photographs are organized by date and GPS coordinates are given for each location. It is recommended that photographic documentation continue in order to visually monitor the health of Cucumber Gulch.

2014 Wetlands Monitoring in Upper Cucumber Gulch Preserve Breckenridge, CO:

Restoration performance monitoring

Jessica Doran and Mark Beardsley, M.S., EcoMetrics LLC, and
Brad Johnson, Ph.D., P.W.S., Johnson Environmental Consulting, LLC

Submitted to the Town of Breckenridge Open Space and Trails Department, February 10, 2015

PURPOSE OF REPORT

This report was prepared to fulfill requirements related to Army Corps of Engineers (Corps) NW-27 Wetlands Restoration Permits # SPK-2012-00780 and # SPK-2012-00781 special conditions #3 and #4 for annual monitoring and reporting. The two permits are part of the same restoration project, so monitoring results have been consolidated into a single annual report. This report generally follows the format described in the Corps Regulatory Guidance letter No. 08-03 dated October 10, 2008. An initial report was submitted in this format (Beardsley and Johnson 2012) describing baseline (pre-project) condition, initial response, and a preliminary assessment of project effectiveness, and an update was submitted last year (Beardsley and Johnson 2013) to describe the results of ongoing post-project monitoring and to update the appraisal of project success, including recommendations. This report is a further revision. Here, we present the results of an additional season of post-project monitoring and explain any changes to the prognosis for success including recommendations for adaptive management and further maintenance. Much of the background information is taken directly from past reports.

i. PROJECT OVERVIEW

(1) **Corps Permit Number**: SPK-00780 (phases 1 and 3) and SPK-00781 (phase 2)

(2) **Permittee**:
Town of Breckenridge
Open Space and Trails Division
c/o Scott Reid
P.O. Box 168
Breckenridge, CO 8042
(970) 547-3155
scottr@townofbreckenridge.com

Consultants:
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c/o Mark Beardsley, M.S.
P.O. Box 1469
Fairplay, CO 80440
(719) 839-1497
mark.ecometrics@gmail.com

Johnson Environmental Consulting, LLC
c/o Brad Johnson, Ph.D., P.W.S.
1518 W. Oak St.
Fort Collins, CO 80521
(970) 490-1388
bjohnson-jec@comcast.net

Party Responsible for Monitoring: EcoMetrics, LLC

(3) Project Summary:

In 2011, EcoMetrics, LLC and Johnson Environmental Consulting, LLC (JEC) completed a comprehensive assessment of wetland condition within the Cucumber Gulch Preserve (CGP) for the Town of Breckenridge (Beardsley and Johnson 2011). In that study, we identified significant reductions in the extent of wetland habitat and impaired functioning in Upper Cucumber Gulch (Upper CG) resulting from the loss of ponds and channel incision which caused widespread lowering of the water table. Channel incision was attributed to external impacts that affect the wetland's water source, sediment balance, and ultimately the loss of beavers from the site. A voluntary, cooperative project was initiated by the Town of Breckenridge and Vail Resorts to restore lost wetland habitat and to improve functional condition on site. The project has so far involved three phases of work covered by two separate Corps permits. A description and work plan for phases 1 and 2 was provided to the Corps by Claffey Ecological Consulting, Inc. on behalf of the Town of Breckenridge on July 30, 2012 (Claffey 2012a and 2012b) and for phase 3 in a letter to the Corps dated August 13, 2013 (Claffey 2013). EcoMetrics and JEC were retained by the Town of Breckenridge to monitor implementation and performance of the project.

The fundamental goal of on-site mitigation is the restoration of lost or degraded beaver ponds and groundwater wetlands to a state as close to natural as possible by alleviating identified human stressors (Beardsley and Johnson 2011). In addition to restoring habitat conditions within the site, the project also aims to ameliorate the effects of off-site stressors by: (1) re-spreading water that is discharged from the contributing watershed to CGP in a more natural pattern at the head of the site (water is presently collected by a drainage system on the ski area upstream of the site and transferred to Upper GG through a 60" culvert); (2) collecting incoming sediment in a catchment pond within Upper CG so that it may be removed before it enters the greater CGP wetland complex; and (3) restoring habitat that encourages immigration and colonization of the site by beavers so that they will continue to maintain ponds, dams, and the water distribution network that supports the wetland. The project is viewed as a rapid response to issues identified in Upper CG which seeks to restore hydrology to the dewatered pond complex while wetland soils and vegetation are still present and while the habitats are still amenable to restoration.

In addition to the original work in Upper Cucumber Gulch, proper, in 2012 (Phase 1), the Town was also granted permission under a separate NWP-27 for aquatic habitat restoration (SPK-2012-00781) downstream from Upper CG (but still within Cucumber Gulch Preserve) known as the "reset pond". This additional corrective action is known as Phase 2 of the Cucumber Gulch Restoration Project, and the objective was to restore depth and structural integrity of the pond at this location by dredging out sediment that had accumulated and repairing the dam that breached after beavers left the area. The long term goal is to restore the pond to a condition that is habitable by beavers so that they will once again come to occupy the area and to maintain the dam which supports the pond, the local groundwater table, and a system of distributary channels that feeds the rest of the wetland downstream. These efforts are aimed at restoring the natural pattern of water outflow from Upper CG to the rest of the wetland complex.

Next, the Town was granted permission by the Corps for Phase 3 of the Cucumber Gulch Restoration Project in 2013. This additional corrective action involved "restoration of approximately 550 linear feet of Boreas Creek using bio-engineering techniques, including log jams, Bio Logs, log wedges, facines (*sic*.), hinge lots (*sic*.), and willow dams" (Corps Permit SPK 2012-00780). The work was

designed to treat portions of the Boreas Creek channel within Upper CG where it was enlarged and incised, so that it may respond by aggrading and becoming more connected with the adjacent floodplain. The primary goal is to protect the recently restored wetland habitats that are adjacent to the channel from the risk of being dewatered when flows become captured by the channel again in the future. The incised channel acts as a barrier to the positive effects of groundwater restoration treatments which were all made on the northwest side of the creek in phase 1. That is, the positive effects of the treatments cannot spread to the southeast side of the creek as long as the channel is incised and enlarged, because it functions as a drain which diverts would-be ground water downstream as surface flow. If the phase 3 work is successful, then we eventually expect to see a heightened groundwater table and improved wetland condition of the southeast side of the creek similar to the improvements seen on the northwest side.

(4) Site Location

The project is located on Boreas Creek and associated wetlands in Section 36, Township 6 South, Range 78 West (Lat: 39° 28' 56.84" Long: 106° 03' 49.47") in Upper Cucumber Gulch near Breckenridge, CO. The site is immediately north of Ski Hill Road, across from the Peak 8 Base of the Breckenridge Ski Area.

(5) Project Timeline/Work Dates

The initial assessment was completed in 2011 with baseline monitoring through the 2012 season. Restoration treatments for Phases 1 and 2 were completed in October 2012 and additional corrective actions (Phase 3) were completed on the incised portion of the Boreas Creek channel in September 2013 (See section 9), with concurrent implementation monitoring. Quantitative post-project monitoring was initiated in spring of 2013 and continued until after the end of the growing season in 2014 (Table 1).

Table 1. *Milestones in the mitigation project.*

Date	Work Action
2011	Comprehensive Wetlands Assessment of CGP (EcoMetrics and JEC)
May-Oct. 2012	Baseline monitoring (EcoMetrics and JEC)
Sept. 2012	Completion of restoration (Phases 1 and 2) (Claffey Ecological Consulting)
Sept. 2012	Implementation monitoring (EcoMetrics)
Dec. 2012	Performance monitoring report (EcoMetrics and JEC)
May-Oct. 2013	Performance monitoring (EcoMetrics and JEC)
Sept. 2013	Completion of channel work (Phase 3) (Claffey Ecological Consulting)
Jan. 2014	Performance monitoring report (EcoMetrics and JEC)
May-Oct. 2014	Performance monitoring (EcoMetrics and JEC)
May-Oct. 2014	Reed-canary Grass management (Claffey Ecological Consulting)
Jan. 2015	Performance monitoring report (this report) (EcoMetrics and JEC)

(6) Baseline Wetland Conditions

Baseline wetland conditions for Upper CG were assessed in 2011 using FACWet 2.0 (Beardsley and Johnson 2011). FACWet variable scores determined at that time are summarized in Table 2, below.

Table 2. *FACWet variable scores for Upper CG as reported in (Beardsley and Johnson 2011).*

FACWet Variable #	Variable Description	Pre-project score
1/2	Connectivity	C
3	Buffer Capacity	D
4	Water Source	D
5	Water Distribution	D-
6	Water Outflow	D
7	Geomorphology	D
8	Chemical Environment	D
9	Vegetation Structure and Complexity	C

Also in 2011, we delineated the wetland boundary in Upper CG with a conservative approach that assumed all questionable areas to be within the wetland boundary (Beardsley and Johnson 2011). In 2012, we initiated a quantitative wetlands monitoring program within Upper CG to measure specific hydrology, soils, and vegetation parameters to better ascertain the jurisdictional status of wetlands on the site. Baseline results from these studies show that the 2011 wetland boundary was indeed very conservative, and in fact the actual extent of wetlands had become much smaller than the area we reported in 2011. Of 14 sample points within Upper CG, only one was found to meet jurisdictional requirements for wetland status, meaning that most of the area we delineated as wetlands at that time did not actually qualify as wetland habitat according to the three technical criteria. By 2012, most of the historic wetland area within Upper CG was dewatered and no longer functioning as wetland habitat. In other words, the extent of wetlands in Upper CG had shrunken to a mere fraction of its former area (see the maps in Appendix B). The aim of this project is to restore the wetland habitat that has been lost, and to maintain it in the best functional condition possible.

(7) Compliance with Performance Standards

Due to the voluntary nature of the project, formal performance standards were not required of this project by either the Corps or the Town of Breckenridge. Performance standards described in section ii (1) represent desired or predicted project outcomes rather than mandated criteria for project success. With minor exceptions, monitoring results indicate that the project is on track to meeting the short-term and long-term performance goals stated in section ii (1). Our most recent appraisal for the water source variable is B-, which is slightly below the stated target. The reduced prognosis for this variable follows from the risk of failure of the engineered water redistribution system at the head of Upper CG project site.

A specific incident provided direct evidence of this vulnerability in 2014 when a lateral channel that distributes a portion of the water from Boreas Creek to the northern portion of the restoration area failed for a portion of the season, resulting in a temporarily depressed water table within the 0.2-acre wetland area fed by the channel (see section iii (4)). Water distribution is also presently rated B- based on the observation that true wetland hydrology has not yet spread across the entire site. Most notably, the wetland area southeast of Boreas Creek near site N still has a water table that is well below wetland criteria. Until the incised Boreas Creek channel achieves better floodplain connectivity, this small area will probably remain relatively dry. If beavers restore dams on the main channel or if that channel bed aggrades significantly, then the positive effects of restored hydrology should expand to this side of the channel, resulting in an increase to the overall water distribution score.

Apart from these two minor shortcomings, the project appears to be on track towards meeting the stated goals and attaining target values for success criteria in all of the other FACWet state variables. Further discussion of this appraisal is made in section ii (2) of this report, and a summary of the monitoring results that support it are provided in section iii. The detailed quantitative monitoring data upon which these conclusions are made are provided at the end of the report, in appendices.

(8) Corrective actions and Adaptive Management

See sections 9 and 10.

(9) Specific Recommendations for Additional Corrective or Remedial Actions

We recommend two remedial actions based on the findings in this study. First, the condition of the lateral branch channel at the inlet to Upper CG should be evaluated and actions taken to assure it will continue to function as designed. At risk is the estimated 0.2 acres of restored wetland up-gradient of the spreader pond that relies on this channel as a water source. The channel is also a secondary water source to the northern cell of the spreader pond. In September of 2014, flow into and through this channel was blocked by accumulated sediment. Once the problem was recognized, it was easily rectified by physically removing sediment from the channel inlet area, but the problem of accumulating sediment will be recurring. Regular monitoring and maintenance is necessary to assure continuous flow in the channel in the future unless a more sustainable solution that passively assures continuous flow can be achieved.

Second, we recommend dredging the accumulated sediment out of the spreader pond soon. 33 cubic yards of sediment has accumulated in the retention cell of the spreader pond so far during the two seasons of monitoring (see section iii (5c)). While there is plenty of volume in the retention cell to accommodate this rate of sediment deposition for years to come, it may be more efficient and ecologically preferable to remove accumulated sediment more frequently rather than waiting longer and removing more at once. At the present time, the accumulated sediment is mostly limited to a delta area at the inlet of the pond that would be easy to reach with the bucket of a track how parked on the end of the maintenance road. The rest of the pond area is deep and still fully functional. As additional sediment is retained in the future, the delta will expand wider, and it will require more and more disturbance to remove it.

The risk of using construction equipment to dredge sediment from the spreader pond is that it will disturb the resident beavers, possibly causing them to leave. Unfortunately, this risk is inherent with using the spreader pond as a sediment retention facility. We suggest that frequent smaller scale sediment removal efforts probably create less overall disturbance and less risk of disrupting the existing beaver population than fewer larger scale efforts. If the sediment can be removed before it spreads into the main portion of the pond, then the amount of disturbance will be minimal.

(10) Adaptive Management and Maintenance

The Town began an aggressive weed management effort in 2014 within Upper CG, and is directing special attention towards treating reed canary grass, which was reported in 2013 to be expanding its foothold within the project area. The extent of other weeds in Upper CG decreased significantly in 2013 following rehydration of the site, but significant weed cover still existed along the periphery of the site and in small patches within it. The Town hired an ecological contractor to specifically deal with these problems. The efforts involved nine weed-pulling/cutting events where a crew of two or three technicians scoured the area to manually remove any noxious weeds encountered. Sixty-four bags of weeds were removed from the site. There were also nine events over the season in which the crew cut or mowed reed canary grass down to its base. The strategy for reed canary grass management is to repeatedly cut the aboveground portion of the plants in the hopes that this will eventually kill them by starving them of energy and nutrients. The tradeoff of these efforts is the increased human disturbance within Cucumber Gulch Preserve that may affect wildlife and trampling of vegetation.

The importance of weed infestation has been mentioned in all of the past seasonal monitoring reports for Cucumber Gulch. If these eradication efforts are successful, then this important stressor will be alleviated or at least minimized and kept under control. The methods employed may require several seasons before any measureable effect can be observed. We therefore recommend that the Town continue with the weed and reed canary grass control program for at least another season and work with the contractors to monitor its effectiveness as well as any negative impacts related to disturbance.

ii. REQUIREMENTS

(1) Performance standards

The 2013 report provides a detailed explanation of project performance standards based on the Functional Assessment of Colorado Wetlands (FACWet) framework which provides a systematic means of articulating and organizing project goals in light of keystone habitat attributes and their expected responses to restoration treatments (Table 3). Because the project is voluntary, formal performance standards were not required, but general narrative goals were stated, and it is important to track project performance regardless of regulatory obligation.

Table 3. *Proposed Success Criteria based on FACWet 2.0 variables (from Beardsley and Johnson 2012).*

FACWet Variable #	Variable Description	Pre-project score	Target score	Success Criterion	Monitoring
1/2	**Connectivity**	C	C	N/A	N/A
3	**Buffer Capacity**	D	D	N/A	N/A
4	**Water Source**	D	B	1. Incoming water from Boreas Cr. is spread laterally in a full "spreader pond" that feeds multiple distributary channels across the width of the complex.	1. Observation, photos, streamflow monitoring
5	**Water Distribution**	D-	B	1. Historic extent and depth of pond habitat restored to abandoned ponds. 2. Water table elevations throughout historic wetland area meet criteria for wetland hydrology.	1. Observation, photos. 2. Water table depth monitoring at 14 test sites within Upper CG.
6	**Water Outflow**	D	B	1. Water out flow distributed through multiple channels and groundwater.	1. Observation, photos
7	**Geo-morphology**	D	B	1. Breached dams repaired and functional. 2. Beavers present and actively maintaining dams. 3. Soil profiles indicate hydric soil throughout historic wetland area. 4. Boreas Creek channel is no longer enlarging or becoming further incised	1. Observation, photos. 2. Observation, photos, wildlife cameras. 3. Soil profiles 4. Channel surveys.
8	**Chemical Environment**	D	B	1. Restoration of the characteristic soil redox environment via reestablishment of the natural saturation regime. 2. Maintain existing water quality	1. Observation, photos, redox monitoring at test sites 2. Evaluate ongoing WQ monitoring
9	**Vegetation Structure and Complexity**	C	B	1. Wetland vegetation is present throughout historic wetland area. 2. Vegetation composition and structure is similar to unimpacted reference condition.	1. Observation, photos, sampling 2. Vegetation plots at test sites, weed surveys, ongoing vegetation monitoring

(2) Appraisal of Performance

In section i (7), we reported that the project appears to be generally in compliance with performance criteria so far. Summary findings are outlined in Table 4 which describes the observed response of FACWet variables relative to the performance criteria listed in section ii (1). The table also identifies portions of section iii in this report where the reader can find the supporting data and evidence that underlie each variable score appraisal. At this point, only the water source, water distribution, and chemical environment variables are rated slightly below the target mark.

Table 4. *Current status relative to pre-project condition and success criteria.*

FACWet Variable #	Variable Description	Pre-project score	Target score	Present score	Current Status Relative to Success Criterion (Summary)	Supporting Data/Evidence (reference to section iii)
1/2	**Connectivity**	C	C	C	N/A	N/A
3	**Buffer Capacity**	D	D	D	N/A	N/A
4	**Water Source**	D	B	B-	1. Lateral branch channel below Boreas Creek culvert diverted water back to upper northern portion of Upper CG for most of the growing season but stopped running in Sept. Spreader pond feeds multiple distributary channels across the width of the complex. Beavers are actively maintaining and increasing the dam and stage of water in the spreader pond.	1. Observations (4a), Boreas Creek discharge monitoring (4b)
5	**Water Distribution**	D-	B	B-	1. Extent and depth of ponds is similar to historic conditions. Beavers present, actively maintaining dams and distributary channels, building new dams, and expanding water distribution. 2. Hydrographs for all test well locations northwest of Boreas Creek show wetland hydrology or nearly wetland hydrology. Lack of wetland hydrology east of Boreas Creek.	1. Observations (5a), Spreader pond survey (5b) 2. Water table monitoring (5c)
6	**Water Outflow**	D	B	B	1. Outflow no longer confined to incised channel and is distributed amongst branched channels and groundwater. Reset pond is re-occupied by beavers that are maintaining the dam and distribution of water downstream.	1. Observations (6a)
7	**Geo-morphology**	D	B	B	1. Beaver dams are functioning and beavers have largely taken over maintaining them. 2. Beaver maintenance of dams and channels is apparent throughout the phase 1 and 2 project areas in 2014 with one new pond created, but no beaver activity has yet been observed in Boreas Creek channel (Phase 3). 3. Minimal erosion on Boreas Creek within 2012 - 2014. 4. Some sediment BMPs applied within contributing watershed (ski area). Approximately 33 c.y. of sediment has been retained in the spreader pond retention cell.	1. Observations (7a) 2. Observations (7a) 3. Observations (7a), Channel surveys (7b) 4. Observations (7a), Spreader pond surveys (7c)
8	**Chemical Environment**	D	B	B-	1. Redox monitoring at 12" depth shows positive indication of anaerobic soil at 11 of the 14 sites indicating successful restoration of soil redox characteristics over most of the site. 2. No significant changes to water chemistry parameters were observed.	1. Observations (8a), redox monitoring (8b) 2. Observations (8a), Water chemistry monitoring (8c)
9	**Vegetation Structure and Complexity**	C	B	B	1. Most plots still had remnant wetland vegetation prior to project, and vegetation conditions improved at all sites. 2. Weed cover appears to be decreasing, aggressive weed management efforts in place.	1. Observations (9a), Quant. veg. monitoring (9b) 2. Observations (9a)

iii. SUMMARY DATA

(1) Site map

Site maps are provided in Appendix A. The maps identify the location of relevant photopoints, study test sites, and Phase 3 treatments made in the Boreas Creek channel.

(2) Baseline and current condition maps

Appendix B includes two maps, one showing the baseline wetland condition of Upper CG as it existed prior to the project, and the second showing current wetland status based on post-project monitoring through 2014.

(3) Photos and photopoints

The monitoring protocol includes photos taken from approximately 40 locations in CGP two to three times per season so that the appearance of these locations can be compared precisely over time. We also took photographs to document each of the geomorphic surveys and at any time and place where it seemed that recording an image might be useful in analyzing trends. One time-lapse camera and three motion sensor cameras were also deployed at different locations on the site to capture gradual changes and the presence of wildlife. These images are organized and stored in a central database which will be made available to the Corps through the Town, if desired. A small subset of these photos is used in this report, and these may be found in Appendix C. Photos are referenced in the text where appropriate.

(4) Water Source (FACWet Variable 4)

(4a) Observations: Prior to treatment, water entering Upper CG from Boreas Creek through the 60" culvert was confined to an incised channel through the length of the project area. Mitigation efforts included construction of a lateral channel to divert a portion of the flow from the Boreas Creek culvert northward along the head of the Upper CG wetland area. This feature was used to restore the water source of the spreader pond and re-establish hydraulic head across the width of the wetland area, allowing the pond to once again activate its numerous outlets and feed the set of distributary channels that spread water laterally downstream. We reported that these treatments were generally functioning after implementation in 2012, but that functioning would be improved if spillways on the constructed dams were blocked to allow water in the ponds to reach the height of dam crests.

Beaver activity started in the fall of 2013 and in the summer of 2014 we observed continued beaver activity on the spreader pond and all of the ponds in the upper gulch (Photos C1 - C3). In 2013 the constructed spillways were dammed by beavers, raising the stage of those ponds. In 2014 beavers continued to raise the crest of the dams on several ponds, including the spreader, further increasing the height of water. This has two observable effects on water source. First, it causes the spreader pond to function as more of a "level spreader" releasing water downstream via a dispersed network of very small channels and sheet-flow instead of through one outlet channel. Second, the heightened water surface adds additional hydraulic head, which elevates groundwater infiltration rates and presumably an expanded range of groundwater recharge. Heightened pond stage has also caused an increase in the wetland habitats surrounding the pond. Furthermore, the locations of the tiny "spillways" along the dam face is

continually changing through the season as beavers work and rework the dam, and this adds a dynamic element to the surface water component of water source. Observations of a new beaver den in the northern cell of the spreader pond in 2014 is an optimistic sign that the benefits of ongoing beaver maintenance to water source from the spreader pond will continue at least into the near future.

The constructed lateral channel bringing water northward to the spreader pond in Upper CG wetland area functioned in 2013 and for most of the growing season in 2014 (Photo C4). While it was working, the channel provided a secondary water source to the areas north and up-gradient of the spreader pond, and groundwater table was effectively elevated in these areas as a result. But on September 11, 2014 this lateral channel stopped flowing as the flow of water into the channel from Boreas Creek was blocked by accumulated sediment. The area at the receiving end of the channel dried significantly as a result. Well A (Photo C5) measures the water table near the outlet of the lateral channel up-gradient of the northern cell of the spreader pond. When the channel went dry, the water table rapidly dropped from six in. below the surface to 36 in. below the surface at this well (see plot in Appendix A). This observation clearly demonstrates the importance of the channel as a water source to this portion of the wetland.

During a site visit on September 29, we saw that the side channel was dry, so we re-activated it by removing a small amount of sediment at the channel invert. This caused the channel to start flowing again, and a resultant increase in water table height at Well A was immediately evident. Depth to water decreased quickly from more than 36 in. to 12 in. within hours. One spike in water table elevation occurred at Well A during the interval between when the channel went dry and when we reactivated it. We suspect that this is the result of temporary flow in the channel following a storm that raised the stage in Boreas Creek to a level that was high enough to overtop the sediment in the channel. The wetland supplied by the lateral channel was not dry long enough in 2014 to threaten its technical status as wetland, but the period of unnatural drying does imply some decrease in function. More importantly, this event highlights the inherent problem of relying on artificial structures and engineering to supply water to wetlands. Because Upper CG is not a part of a naturally functioning watershed system, frequent and ongoing monitoring is necessary to maintain ecological viability. Maintenance must be performed quickly in response to identified needs and the development of new problems, such as additional weed infestations to assure continued proper functioning.

The area of wetland that depends directly on the lateral channel as a water source is approximately 0.2 acres. But in addition to this, the channel serves as an important secondary water source to the north cell of the spreader pond, which in turn supports its own system of distributary channels that supply a larger wetland area north of the main spreader pond. Therefore, maintaining the integrity of the lateral supply channel must be a top priority of a successful management plan.

(4c) Boreas Creek discharge: Water discharge of Boreas Creek at the inlet to CGP was measured within the culvert using a datalogger with depth and velocity sensors that recorded every 10 minutes from May through September in 2012 and 2013. In 2014, the datalogger was used to continue tracking velocity as a surrogate of flow. These data show a continued seasonal pattern of flow with a broad snowmelt peak through June. The greatest flows, however, occur during rain events. These peaks

tend to last just a few hours or days. Flows in Boreas Creek have been perennial for the duration of the monitoring period.

(5) Water Distribution (FACWet Variable 5)

(5a) Observations: In 2012, we reported that all of the ponds within Upper CG were dry for the majority of the season. Treatments made in fall of 2012 successfully restored the major ponds on Upper CG. At the same time flows were restored to the major arteries of the channel distribution system. These conditions persisted through 2013. In August of 2013, beavers re-inhabited the area, and their activities raised the stage in several existing ponds, created additional ponds, and activated a wider set of distributary channels.

In 2014, we observed continued beaver activity resulting in dramatic changes in dam and water elevations. As a result, the surface area and depth of water was improved on most ponds causing an overall increase in lentic open water and emergent habitat. The distribution of water downstream from the spreader pond is also continuing to improve as ongoing beaver activity maintains flow in the network of distributary channels that pour over the dam and the maintenance of a high groundwater table and hydraulic head.

One small pond towards the middle of Upper CG did go dry after it drained through an opening in the base of the dam (Photo C6). This pond is on the northern side of the gulch in close proximity to the "stump den" where a beaver family with kits was living. It is possible that the drained pond may have been related to the conditions of the den. When the pond is full, this den is flooded and unusable, and we hypothesize that beavers could be purposefully not damming this pond, allowing it to stay dry so that it will not flood the den. All the other ponds in the immediate vicinity are being well maintained by beavers and increasing in size and depth, indicating that beavers are fully active in this area.

(5b) Water table monitoring: We established well sites at each of the 14 monitoring test plots in Upper CG (See the site map in Appendix A) and used automatic data-logging wells to monitor the depth of the water table every six hours. Hydrographs from these well sites are provided in Appendix E. For each well location we measured the amount of time during the 140-day period from May 27 to Oct 14 that the water table was shallower than 12 in. This sum is reported as total hydric days (THD) for that location. We also calculated the duration of the maximum length of time for which the hydrograph shows the water table at less than 12 in. deep. This figure is reported as consecutive hydric days (CHD). The jurisdictional requirement for wetlands is 14 CHD during the growing season.

THD and CHD results for 2014 are shown in Table 5. All but three of the sites showed positive wetland hydrology in 2014. Seven of the well sites (B, C, D, K, G, H, and I) are located in areas that are now ponds. These sites were submerged under surface water for the entire 2013 and 2014 seasons.

The three well sites that did not show wetland hydrology in 2014 are E, J and N. Well E is located down-gradient of the north side of the spreader pond on a steep slope below the dam. This site met criteria for wetlands hydrology in 2013 but not in 2014. During the 2014 growing season, the water table was steady at 14 in. below the surface for the first third of the season before dropping off gradually

to 21 in. It is possible that fluctuations in the spillway locations from the spreader pond may have altered the source of surface water to the area around the well. Interestingly Well F, located south of Well E but also on the backside of the spreader pond dam face, did not meet wetland hydrology qualifications in 2013 but did in 2014. Essentially these neighboring wells have alternated wetland hydrology status in 2013 and 2014, suggesting that their water sources are linked in a complicated matter.

At Well J, the water table was consistently around 26 in. below the surface. This is deeper than what we observed during the 2013 season which was about 15-20 in. This well is adjacent to the small pond that went dry in 2014 (discussed in section iii. (5a)), and this may be the reason for a declining water table elevation at the well. At Well N, which is on the opposite side of Boreas Creek from the treatments, no measureable response in the hydrograph was detected in 2013. During 2014, the water table was generally 34 in. below the surface but there were periods where it rose to within 22 in. These spikes are consistent with observations of beaver activity increasing the surface water elevation in the ponds nearest to Well N, and on several site visits we observed surface water flowing east from Boreas Creek just downstream from Well N. If the current level of beaver activity continues, we expect to see more hydric conditions on the east side of Boreas Creek in the area of Well N.

Table 5. *Hydrograph summary for water table monitoring. Sites shaded in red did not show wetland hydrology. Sites shaded in green or blue indicate positive wetland hydrology, with blue indicating pond habitat and green terrestrial wetland habitat.*

Site	2012 THD	2012 CHD	2012 Wetland hydrology (by hydrograph)	2013 THD	2013 CHD	2013 Wetland hydrology (by hydrograph)	2014 THD	2014 CHD	2014 Wetland hydrology (by hydrograph)
A	0	0	Negative	99	98	Positive	106	105	Positive
B	0	0	Negative	150	150	Positive	140	140	Positive
C	0	0	Negative	150	150	Positive	140	140	Positive
D	0	0	Negative	150	150	Positive	140	140	Positive
E	0	0	Negative	45	45	Positive	0	0	Negative
F	0	0	Negative	N/A	N/A	Negative	62	47	Positive
G	2.5	2	Negative	150	150	Positive	140	140	Positive
H	N/A	N/A	Positive	150	150	Positive	140	140	Positive
I	0	0	Negative	150	150	Positive	140	140	Positive
J	0	0	Negative	0	0	Negative	0	0	Negative
K	N/A	N/A	Negative	150	150	Positive	140	140	Positive
L	0	0	Negative	150	150	Positive	140	140	Positive
M	5.5	2	Negative	150	150	Positive	140	140	Positive
N	0	0	Negative	0	0	Negative	0	0	Negative

(6) Water Outflow (FACWet Variable 6)

(6a) Observations: Phase 2 of this project was aimed at improving the transfer of water from Upper CG to the lower wetland complex through the reset pond. Prior to the restoration, beavers had abandoned the reset pond which had become filled with sediment. The dam was breached, and a new actively incising channel was forming through its bed which meant that the bulk of water exiting the area was confined to that newly forming channel. After dredging sediments from the pond and repairing the dam, immediate improvement to the water outflow pattern was apparent with a raised stage of water behind the dam and activation of a system of small distributary channels downstream of the dam. Remedial actions were taken by the Town in early 2013 to prevent erosion at the outlet of the pond, prior to beaver occupation.

Beavers moved into the pond in 2013 and have been maintaining the dam since. During 2014 they continued to raise the height of the dam, causing increases in the depth and surface area of the pond (Photo C7). Outflow from the reset pond is via numerous distributary channels that spill over the dam and as well as groundwater recharge driven by hydraulic head in the pond. This is exactly how the pond was intended to function for outflow. There is also increased beaver activity above the reset pond southeast of the main Boreas Creek channel that created a secondary active water inlet to the Reset Pond. This is a positive development as the resilience of the system is enhanced with multiple water sources to the reset pond.

(7) Geomorphology (FACWet Variable 7)

(7a) Observations: The terraced, dam-and-basin topography of Upper CG is created and maintained by beavers. Restoration treatments reestablished this topography where it had been lost through sedimentation and channel incision. Beavers have returned to Upper CG and have taken up pond maintenance activities. In 2013, the new resident beavers became active in Upper CG and in August 2014, we captured a series of images of a kit beaver near the "stump den" (Photo C8). The development of the beaver population in Upper CG is the key to maintaining functional geomorphology of the system for the long term so these observations are very encouraging.

Phase 3 work took place in September with numerous treatments made along a 550-ft length of the Boreas Creek channel. Along this reach, several breached and eroded dams were repaired to spread water, and materials were added to the channel bed to increase its roughness and encourage deposition of sediments (Photo C9). All the treatments were stable during the 2014 runoff, with no deleterious changes to the bed elevation or bank stability of the channel.

There was no beaver activity observed within the Boreas Creek channel during either 2013 or 2014, but the repaired dams on the downstream end of the project (station 605 and 675) continue to function in much the same way as natural beaver dams (Photo C10). As long as Cucumber Gulch beaver population remains healthy, we expect that beavers will eventually take up residence in these ponds and expand dam building activity along the remainder of the Boreas Creek channel in coming years. There are no distributary channels leaving the main channel within the phase 3 treatment area, but there are several locations were water enters the channel from the pond complex in the upper gulch. This indicates

that the creek channel continues to act as the main water transport out of the upper portion of Upper CG. Additional beaver activity on the reach would be a welcome geomorphic agent to decentralize water export from the reach through the activation of additional side channels.

At the head of Upper CG, we documented significant sediment deposition at the mouth of the lateral spreader channel near Well A and at the inlet to the north cell of the spreader pond. Some fraction of sediment is being diverted through the lateral spreader channel and into the Upper CG, effectively bypassing the spreader pond sediment retention cell. This is a mild to moderate geomorphic stressor, but one that should be monitored over time. More importantly, sediment deposition at the head of the lateral channel has already been enough to effectively block flows from entering the channel from Boreas Creek.

At the bottom of Upper CG, observations and photo points indicate that there has not been significant sediment accumulation in the reset pond over the past two seasons. This is important since continued beaver presence at the reset pond would be threatened by accelerated and their presence in the reset pond is critical for maintaining water distribution and erosion control for the lower gulch.

(7b) Channel surveys: We continued monitoring Boreas Creek geomorphology through 2014 with a detailed longitudinal profile and cross section (XS) surveys of the Upper CG reach. The profile and relevant XS plots can be found in Appendix G. Comparison of the 2013 and 2014 longitudinal profile shows little change in the bed elevation, and this supports our general observations that the treatment structures have been stable. There was some deposition near XS 6, between station 455 and 485. An average of 1.0 to 1.5 ft. of bed aggradation was observed on this 30 ft. segment upstream from one of the grade control structures. The purpose of the structure was to induce deposition to passively raise the bed, so this result indicates this structure is functioning as desired.

Apart from the segment above XS 6, elsewhere along the channel there has been little sediment accumulation or bed aggradation. This is likely the result of the upstream sediment retention and their effectiveness at reducing sediment load. Under the new sediment regime, the ability of the channel bottom to aggrade will not be known until there is a longer period of record for monitoring.

None of the XS surveys show any significant changes in channel dimensions. The minimal changes in both the longitudinal profile and XS surveys are an expected outcome of upstream restoration treatments. The diversion of flow limits the amount of incoming sediment and stream power in the channel, so as long as the Upper CG wetland complex is functioning, the risk of rapid geomorphic change via deposition or erosion appears minimal. One agent that could induce rapid change and recovery of the incised Boreas Creek channel is beaver workings, but when or if this will occur cannot be predicted.

(7c) Spreader pond surveys: One of the restoration objectives is to restore the depth and extent of pond habitat. Monitoring this performance criterion involves observational monitoring, but we also made quantitative surveys of the east cell of the spreader pond to track the decrease in pond depth caused by sediment accumulation (see Appendix F). Prior to the project, the spreader pond had become full of sediment to the height of the dam and a deeply incised channel eroded through it. The pond was reestablished in 2012 as a result of restoration treatments.

Table 7. *Soil redox summary*

Site	Redox patterns indicative of anaerobic soil chemistry		
	2012	2013	2014
A	negative	positive	positive
B	negative	pond	pond
C	negative	pond	pond
D	negative	pond	pond
E	negative	negative	negative
F	negative	negative	positive
G	negative	positive	pond
H	positive	pond	pond
I	negative	pond	pond
J	negative	negative	negative
K	negative	positive	pond
L	negative	positive	positive
M	negative	positive	positive
N	negative	negative	negative

In 2013 the water surface elevation of the pond came up 0.7 ft., and in 2014 there was a similar elevation increase. The 1.4 foot gain in pond elevation measured since restoration has resulted from the continual maintenance and improvement of the pond dam by resident beavers. These changes are evident in the cross section overlays in Appendix F.

At the same time, sediment accumulation in the pond was acting to decrease depth and volume. Thirty-three c.y. of sediment have been captured in the spreader pond which increased its bed elevation by as much as 2.5 ft. The deposition delta that Boreas Creek is forming has elevated the pond bottom by an average of 1.5 ft. At this rate, the depth and extent of the pond will continue to decrease until it becomes full of sediment in an estimated five to ten years.

The maintenance of pond depth is at odds with this pond's intended role as a sediment retention basin to prevent ponds further downstream from becoming similarly filled; therefore, it was designed so that it could be periodically dredged. This restoration strategy appears to be working as the amount of deposition in ponds downstream of the spreader has been minimal.

(8) Chemical environment (FACWet Variable 8)

(8a) Observations: In fall of 2012, we investigated reports of increased algae and elodea blooms in CGP, because there appeared to be more of both these plants in ponds this season compared to previous ones. After evaluating multiple lines of evidence, we concluded that the increased aquatic vegetation levels seen on CGP that season were the result of a more widespread response to drought and weather rather than an indication of water pollution. Normal levels of aquatic vegetation were generally seen in 2013 within CGP which further supports this explanation. In 2014 we saw normal levels of aquatic vegetation in the wetland ponds, but we did document what appeared to be increased aquatic vegetation and algae in Boreas Creek itself (Photo C11). This observation runs contrary to the conclusion that excessive vegetation is related to drought. The issue was limited to the reach of Boreas Creek within the Upper CG project area between the spreader pond and the reset pond. Downstream from the reset pond, the level of aquatic vegetation appeared typical. We also observed the neighboring drainages of Barton and Sawmill creek and found that vegetation levels were normal in these areas as well. Therefore, we speculate that these observations indicate a potentially elevated level of incoming nutrients to the site from upstream. If this is true, then results for increased nutrient levels should be observable in 2014 water quality monitoring data, however, those data are not yet available.

(8b) Redox probes: Soil chemistry: Prior to the project in 2012, the breadth of the site showed unnatural periods of drying and unsaturated soil which indicate that a wetland chemical environment was

not present across most of the study area. The primary aim of the restoration regarding soil chemistry was to reestablish a redox environment through hydrologic restoration. Each of the test sites that was not in a pond was equipped with platinum-tipped redox electrodes set to a depth of 12 in. We made periodic site visits to measure redox potential of the soil at these plots using an electric circuit connecting the redox probe to a reference Ag/AgCl electrode. This test provided a quantitative indicator of the presence of anaerobic soil chemistry based on the measured value of redox potential, expressed in mV of current in the circuit. Results for soil redox monitoring on Upper CG through the 2014 season are provided in Appendix H and summarized in Table 7. Prior to treatment in 2012, only one of the test sites, site H, showed an anaerobic pattern of soil redox that is typical of peat-forming wetlands. Dry aerobic conditions existed at all the other sites prior to treatment.

In 2014, redox probes recorded a similar pattern to that measured in 2013 except that site F switched from aerobic to anaerobic near the beginning of September and remained anaerobic for the rest of the 2014 season. Redox values for site A were significantly higher in 2014 compared to the first half of 2013, but still within criteria for anaerobic soil and a reducing chemical environment. At this point, only three of the sites are negative for anaerobic soil conditions. These include the peripheral sites J, N and E which all still have non-wetland hydrology.

(8c) Water quality data: The Breckenridge Ski Area has been contracting with a separate consultant to complete detailed water chemistry monitoring throughout CGP and the contributing watersheds within the ski area since the early 2000s, and annual reports are made available to the Town. We collect the data from these reports into a separate database for the Town so we can monitor water quality parameters and scan for "red flags" or indications of change that suggest a threat to water quality. At the time of this report no new water quality data for 2014 has been made available, so we have no additional analysis since the 2013 report.

(9) Vegetation (FACWet Variable 9)

(9a) Observations: Prior to treatment in 2011 and 2012, there was an emerging weed problem apparent in Upper CG as weeds had been colonizing the recently dried pond beds and newly deposited sediment. Ponds and wet soil conditions have been restored to most of these locations which has eliminated a large portion of the weed population in the study area. An exception to this pattern is the recent spread of reed canary grass which is not considered a noxious weed but is nonetheless a resilient, invasive, exotic species. This species appeared to be spreading in the re-saturated soils and even as emergents in some of the restored ponds. An aggressive reed canary grass eradication program began in Upper CG in 2014. Effectiveness of these efforts will be determined after several seasons.

(9b) Quantitative vegetation monitoring: More generally, most of the project area already had remnant wetland vegetation present prior to treatment, and it appears to be thriving in the re-saturated condition. The vegetation monitoring plots at every one of the study sites show improved condition based on prevalence index (Table 8). Prior to treatment in 2012, there were three sites that did not meet criteria for wetland vegetation. These three sites were all within abandoned ponds in 2012, and vegetation was primarily composed of upland weedy species at that time. The sites are now restored pond habitat.

Table 8. *Vegetation prevalence index summary. A prevalence index of 3.00 or less indicates the presence of wetland vegetation.*

Site	Prevalence Index	
	2012 (pre)	2014 (post)
A	2.17	1.90
B	2.65	pond
C	3.03	pond
D	3.00	pond
E	1.81	1.39
F	1.46	1.26
G	3.22	pond
H	1.67	pond
I	3.17	pond
J	2.89	2.49
K	2.61	pond
L	2.85	2.18
M	2.15	1.84
N	2.40	0.93

iv. MAPS

Appendix A contains two maps showing the location of photopoints and monitoring test sites in Upper CG, respectively. Construction designs and site plan maps are provided in Claffey 2012a and 2013. Appendix B contains a map showing the extent of wetlands as delineated in 2007 and 2011. This map also shows the results of quantitative tests made in 2012 to define the baseline condition of wetlands for this restoration project. A separate map in Appendix B shows the current status of wetland determination at the 14 test sites based on post-project monitoring data through 2014, indicating widespread restoration of hydrology and wetland status following treatment.

v. CONCLUSIONS AND RECOMMENDATIONS

The 2013 report concluded by stating that "*the project appears to be on track towards meeting success criteria in the restoration of quality wetland habitat within Upper CG*," and that "*the main questions now are whether these positive changes will be sustainable and whether the improved condition will spread over a greater area*." Results from the second season of post project monitoring in 2014 yield no major changes to the prognosis that was made immediately after completion of the project. In general, the results are positive, and by and large the changes appear to be sustainable and persistent. The immediate reoccupation of the site by beavers and recovery of the basic maintenance functions that this keystone species provides is especially promising.

At present, our assessment of wetlands functional condition in the Upper CG project area is close to the target values for all FACWet variables. The water source, water distribution, and chemical environment variables are rated slightly below target condition due to very limited shortcomings in specific parameters relative to success criteria. But these are minor deficiencies compared to the overall level of success in restoring function. The extent of restored aquatic habitat and wetland area has continued to spread through 2014, and this trend will likely continue at a reduced pace in the future. If the beaver population remains healthy and expanding in Cucumber Gulch, then we expect beavers to

eventually begin damming the remaining incised segments of Boreas Creek which would effectively allow the recovery of wetlands east of the channel.

A major caveat to the general prognosis of success is that sustainability and continued functioning of the restored habitat in Upper CG is very much dependent upon ongoing monitoring and maintenance. Maintianing the function of the spreader pond is critical to success in all aspects of this restoration. An effective monitoring and response program in Upper CG will continue to involve regular observation, quick response to emerging issues and frequent dredging to remove accumulating sediments that are continually being delivered from the impaired watershed upstream. We recommend dredging the spreader pond often, while sediments can be easily removed with minimal disturbance and risk of disrupting critical beaver populations. We recommend that the first dredging operation be planned for 2015.

Similarly, the function of the lateral spreader channel must be regularly monitored and maintained to avoid events where the channel stops flowing. A small but significant amount of wetland (about 0.2 acres) depends on this water source directly, and much of the northern wetland habitat is indirectly supported by this water source.

The third variable for which some under performance was noted is chemical environment. Elevated levels of aquatic vegetation and algae on Boreas Creek in Upper CG suggests a potential increase in incoming nutrients. If this hypothesis is true, then elevated nutrient levels should be apparent in water quality samples from the water supply areas. There is a great deal of detailed water quality monitoring taking place in Upper CG, but the results are usually not available quickly enough to allow for the timely detection of problems. The likelihood of overall restoration success would certainly be improved if real-time data were available to detect potential problems. As such we recommend the Town considers reinstituting some basic real-time monitoring of water quality for easy to measure parameters such as conductivity, in addition to detailed laboratory analyses.

Finally, we recommend that the Town continue its aggressive weed eradication and reed canary grass control efforts. Specific monitoring aimed at determining the effectiveness of these efforts as well as the impacts of disturbance related to these activities would be valuable in determining how to proceed with weed and invasive species control in the future.

The basic natural infrastructure supporting wetland functioning is in place and operational in the Upper CG project area, but due to the effect of external stressors such as modified hydrology, incoming sediment, chemical issues and weeds, keeping it functional will continue to require effort. Vigilance and adaptive management are necessary to assure long term project success.

vi. REPORTS CITED

- Beardsley and Johnson. 2011. *A Comprehensive Assessment of Wetland Condition in Cucumber Gulch Preserve, Breckenridge, Colorado.* Submitted to Town of Breckenridge. October 31, 2011.
- Beardsley and Johnson. 2013. *2013 Wetlands Monitoring in Upper Cucumber Gulch Preserve Breckenridge, CO: Restoration performance monitoring.* Submitted to Town of Breckenridge. January 14, 2014.
- Beardsley and Johnson. 2012. *2012 Wetlands Monitoring in Upper Cucumber Gulch Preserve Breckenridge, CO: A report of baseline conditions and initial indications of success for wetlands restoration.* Submitted to Town of Breckenridge. December 26, 2012.
- Claffey Ecological Consulting, Inc. 2013. *Cucumber Gulch Boreas Creek Restoration.* Submitted to Lesley McWhirter, US Army Corps of Engineers . August 12, 2013
- Claffey Ecological Consulting, Inc. and Five Rivers, Inc. 2012a. *UPPER CUCUMBER GULCH, Breckenridge, Colorado, RESTORATION PLAN.* Submitted to Town of Breckenridge, Open Space and Vail Summit Resorts. July, 2012.
- Claffey Ecological Consulting, Inc.. 2012b. *REQUEST FOR VERIFICATION OF NATIONWIDE GENERAL PERMIT AUTHORIZATION. CUCUMBER GULCH RESTORATION PROJECT. PHASE 1, STAGE 2 & PHASE 2.* Submitted to Army Corps of Engineers Sacramento District, on behalf of the Town of Breckenridge Open Space and Trains Department, Scott Reid. July 25, 2012.
- Johnson, J.B., M. Beardsley, and J. Doran. 2010. *Functional Assessment of Colorado Wetlands Version 2.0*. Colorado Department of Transportation Research Report.

APPENDIX A: SITE MAPS

Fig. A1. *Location of monitoring photopoints (numbered stars) across the greater Cucumber Gulch Preserve. Photopoints relative to monitoring project effectiveness on Upper CG include #1, 2, 3, 26, 27, and 28.*

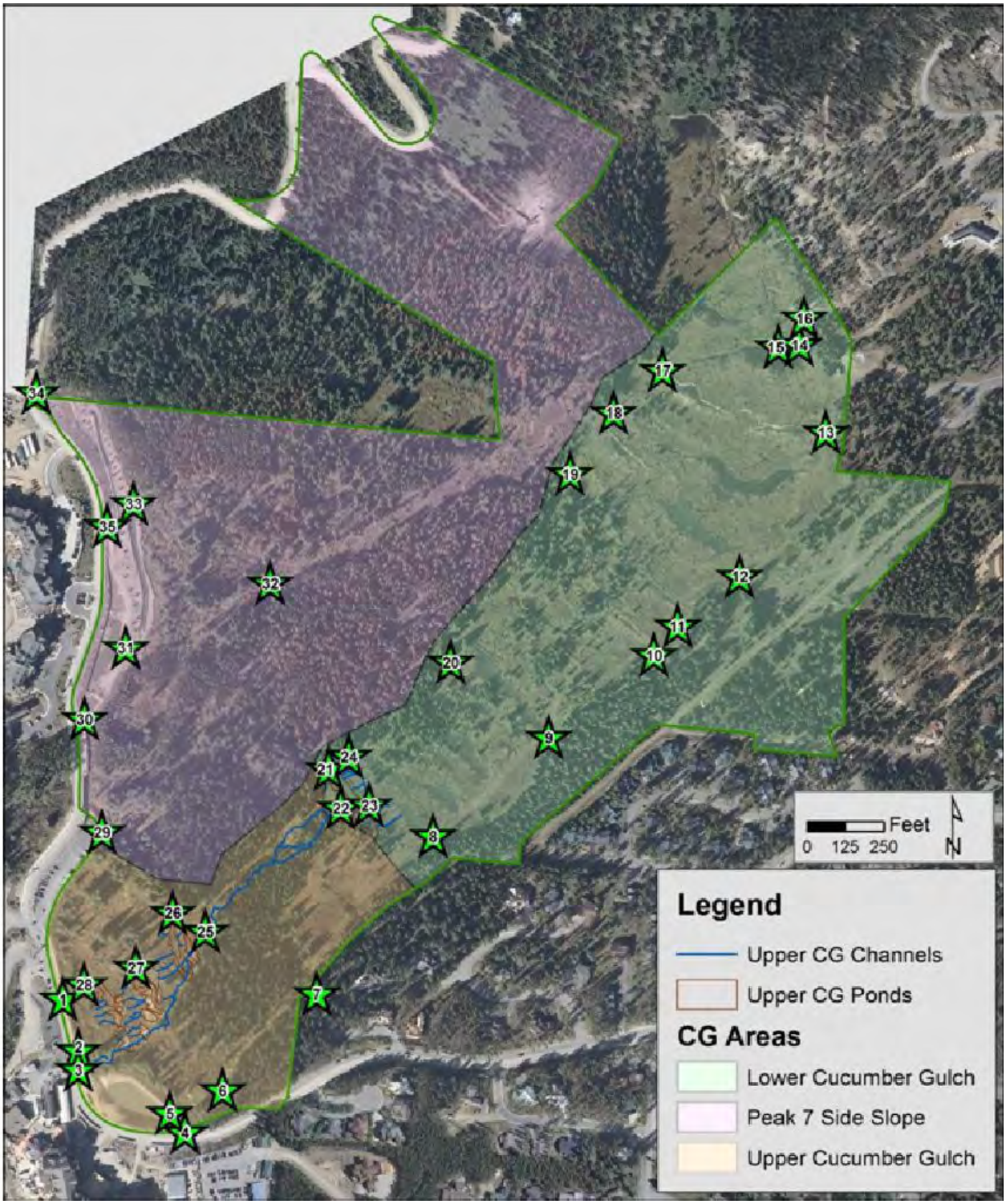


Fig. A2. *Location of monitoring test sites within Upper CG. Each site is equipped with a groundwater monitoring well and datalogger, redox probes, vegetation sample plot, and soil profile point. 2007 and 2011 wetland delineation boundaries are shown as well, so that the location of test sites relative to purported wetlands can be easily ascertained.*

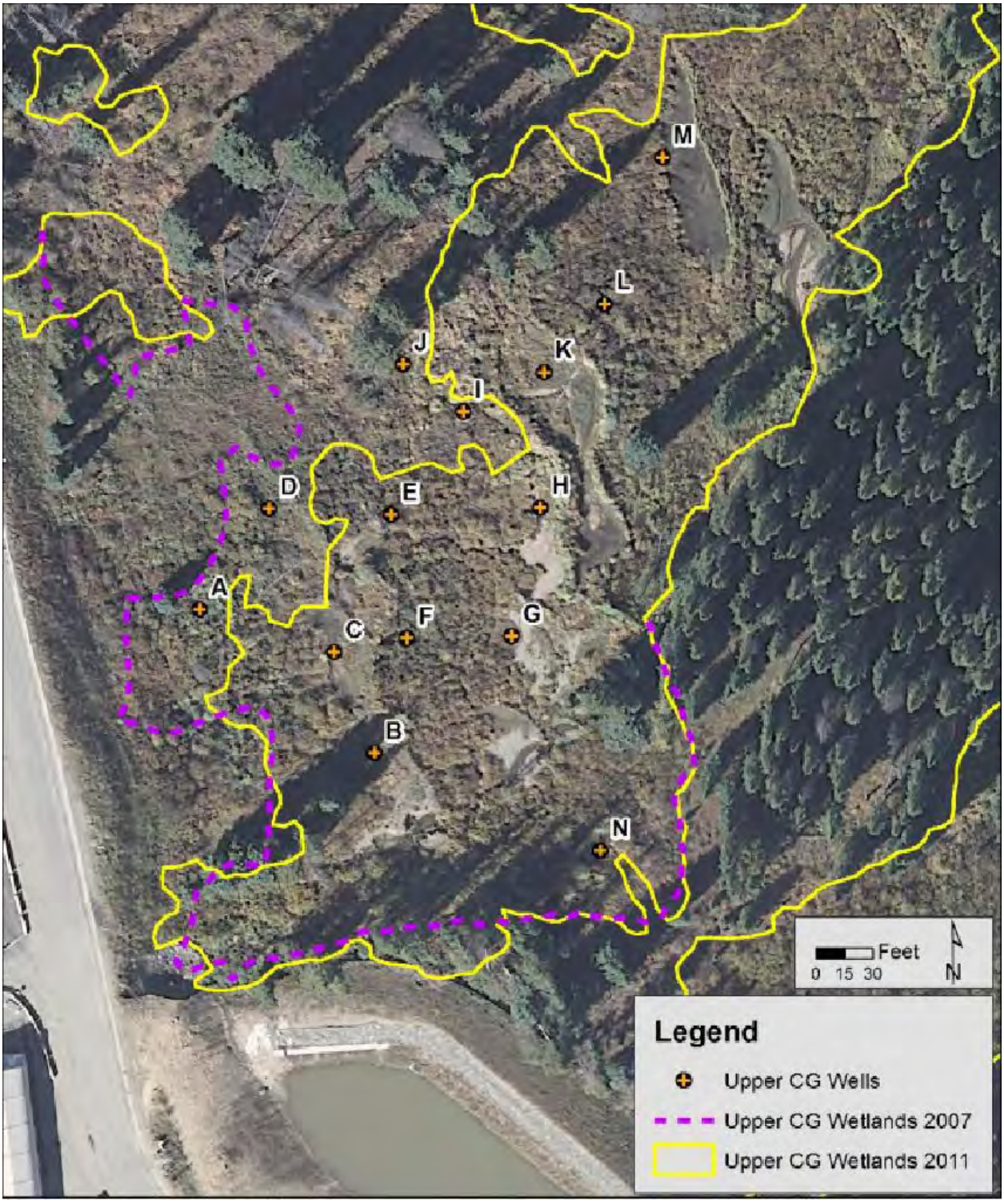
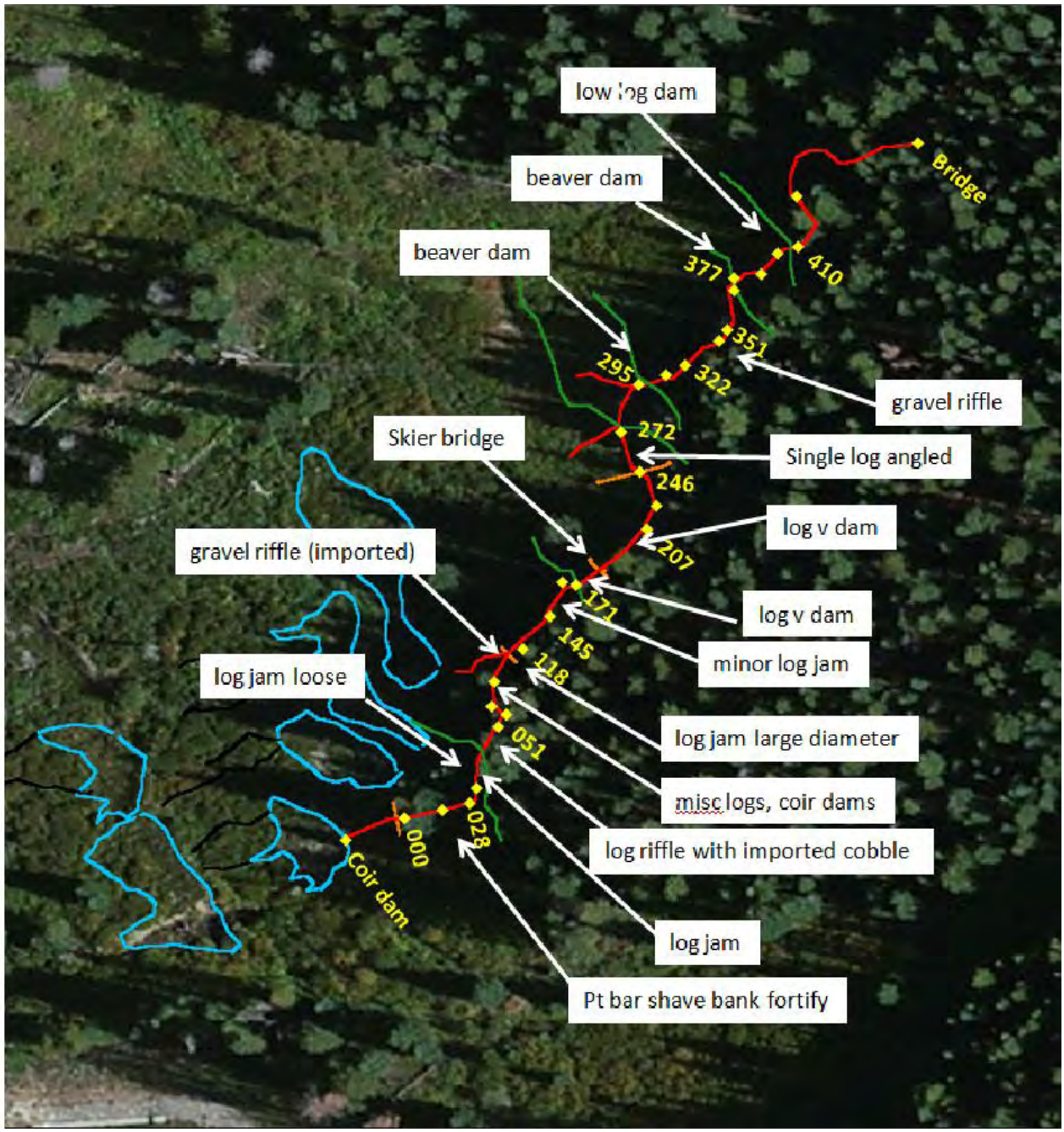


Fig. A3. *Location of Boreas Creek channel treatments. Yellow numbers indicate station along the right bank of the channel, in feet.*



APPENDIX B: WETLANDS CONDITION MAPS

Fig. B1. *Results of 2012 baseline monitoring of wetlands condition in Upper CG are depicted on this map. The concentric circles at each test site indicate wetlands status based on hydrology (inner circle), vegetation (middle circle), and soils (outer circle). Green indicates the presence of a wetland indicator, red indicates the absence of a wetland indicator, and grey indicates the presence of relict hydric soils that presently lack hydrology. Of all these test locations in 2012, only site H possessed all three wetland criteria. Comparison of the quantitative results to recent wetland delineations shows that the wetland area had actually contracted much more than was reported in 2011.*

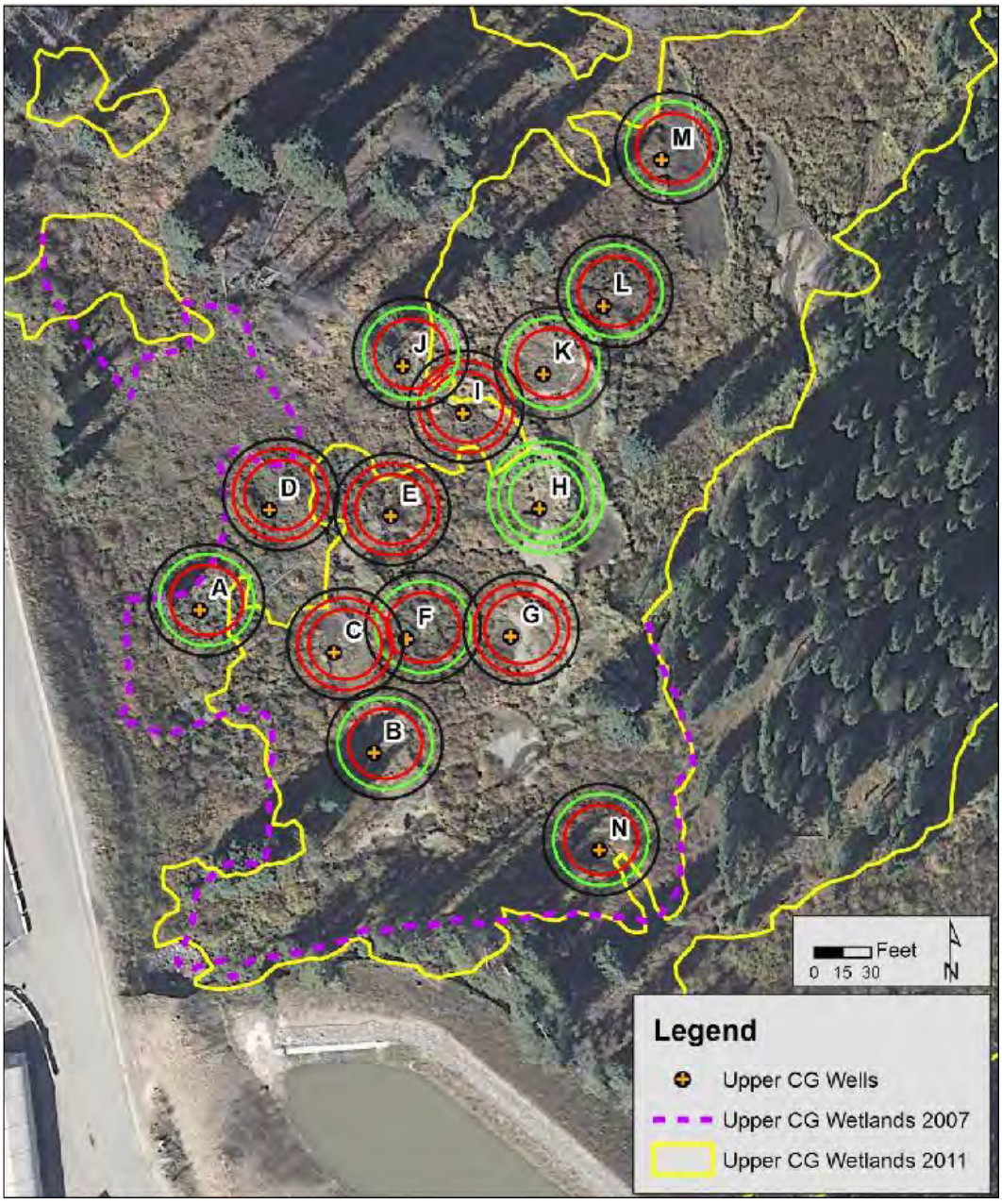
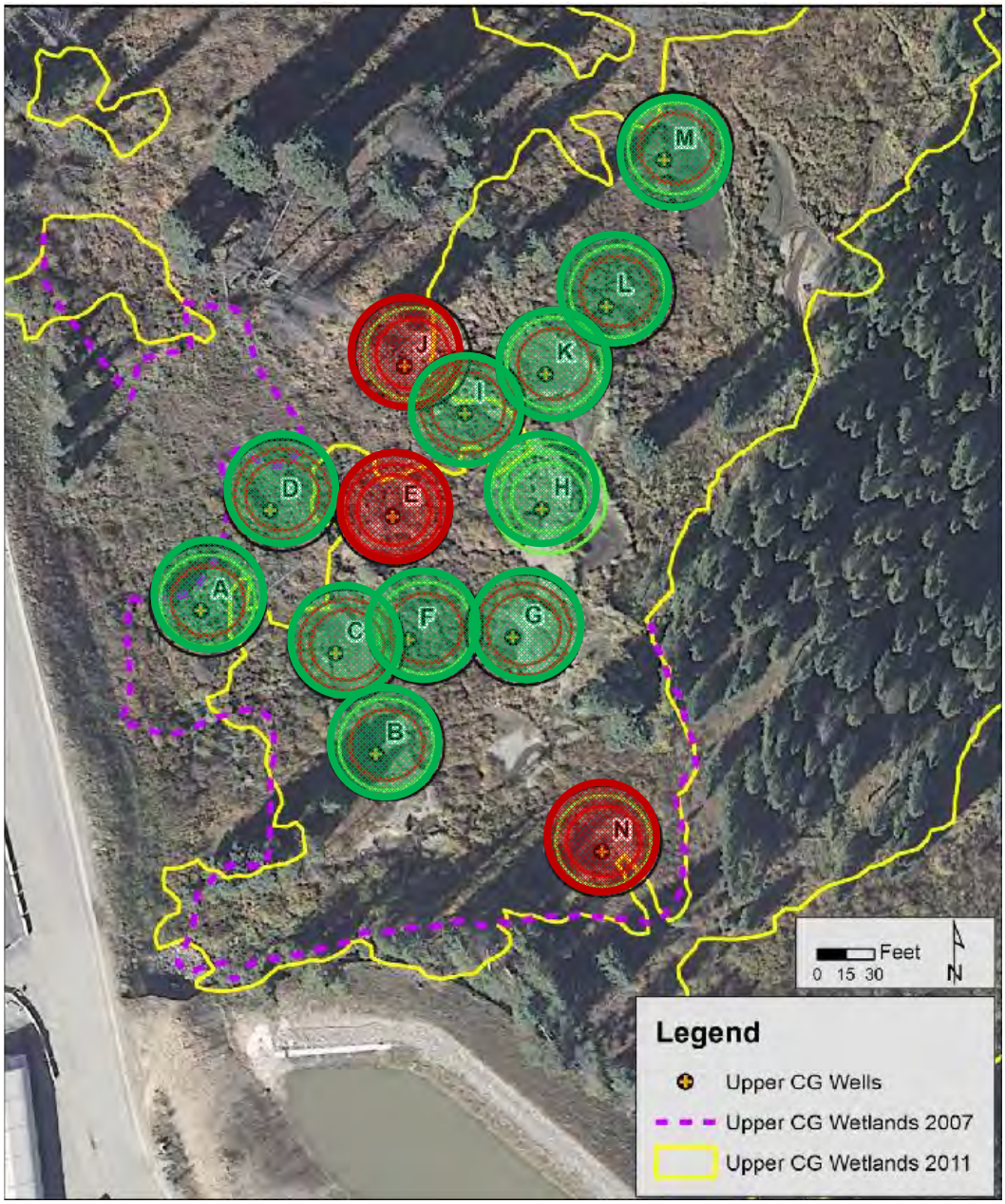


Fig. B2. *Post-project data through 2014 indicates restoration of wetland habitat on 11 of the 14 test sites. On this map, sites circled in green are those for which all three criteria for wetlands presently exist. Sites circled in red lacked wetland hydrology in 2014.*



APPENDIX C: PHOTOS

Photo C1a. *The outlet spillway of the northern cell of the spreader pond in 2012 immediately after construction.*

Photo C1b. *This is the same location as Photo C1a in mid-summer of 2014 after the beavers had dammed the spillway and continued raising the height of the dam around the pond.*

Photo C1c. *Two photos showing the upper (eastern) cell of the spreader pond as viewed from upstream in September 2014, when the dam is at its highest. Water flows out of the pond over the dam (right side of photo) at multiple locations, creating natural water distribution.*

Photo C2a and b. *Overview of Upper CG restoration. The upper photo is before treatment in 2012 and the lower photo is from summer 2013.*

Photo C2c and d. *Overview of Upper CG restoration. The upper photo is spring 2014 and the lower photo is from summer2014.*

Photo. C3. *Restored of beaver pond habitat downstream from the spreader pond in 2012 and 2014.*

Photo C4a. *This photo shows where the lateral channel (green arrow) splits off from Boreas Creek just downstream from a boulder energy dissipation structure.*

Photo C4b. *The left photo shows the inlet to the lateral channel immediately after construction in 2012. The right photo shows the same area in 2014 after flows to the channel were blocked by accumulated sediment. We restored flows to the channel on this day by digging a small trench through the deposited sand and gravel.*

Photo C5. *Deposition at Well A. The left photo shows Well A in 2012 and the right photo shows it during runoff in 2014 (from a different angle). The flowing water is outflow from the lateral spreader ditch. Note the amount of sediment deposition.*

Photo C6. *Photos of the pond that drained in 2014. The pond drained through a hole in the dam which is circled and shown in the inset photo. An adjacent occupied beaver den is also shown. Note the proximity of well J to the pond. The water table dropped when the pond drained.*

Photo C7a. *Reset pond early in 2012, prior to restoration.*

Photo C7b. *Reset pond early in 2013, after restoration but before beavers occupation.*

Photo C7c. *Reset pond early in 2014 while beavers are active and residing in the pond.*

Photo C8.*Photos of two beaver kits captured on a game camera near the "stump den."*

Photo C9. *Typical Phase 3 channel treatments. The left photo shows a segment in 2012 prior to treatment and again in 2014. Treatments on this segment include a log jam (background) and a v-shaped log bed feature (foreground), fill to raise the bed elevation, and riparian planting.*

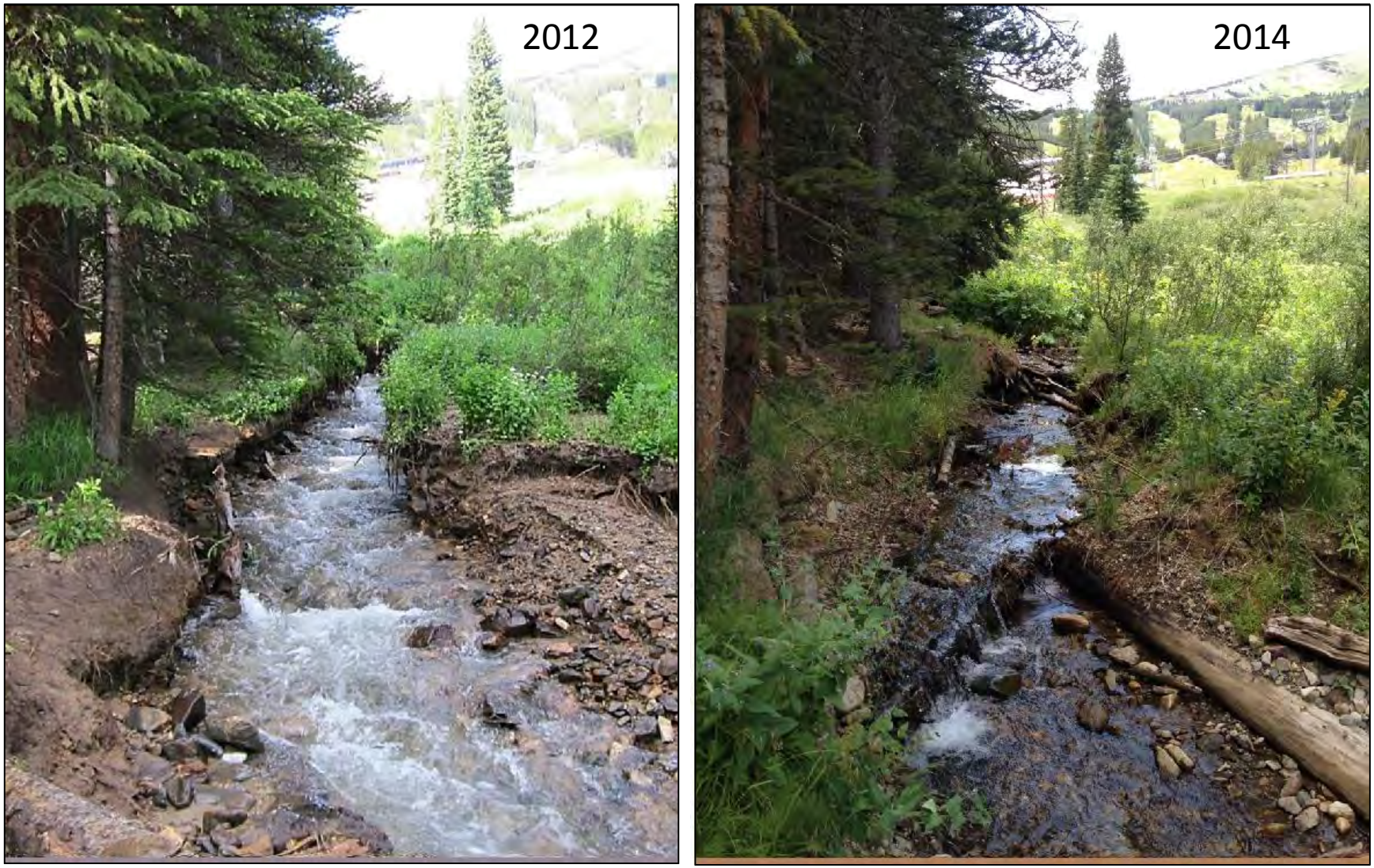


Photo C10. *"Artificial" beaver dams constructed at station 605 (upper photo) and 675 (lower photo) are intended to function until beavers return.*

Photo C11. *Excess aquatic vegetation and algae was observed in Boreas Creek on the project area in 2014.*

Photo C12. *A moose making use of the restored habitat in Upper Cucumber Gulch.*

APPENDIX D: VELOCITY GRAPH FOR BOREAS CREEK

Fig. D1. *Velocity of water within the Boreas Creek culvert is a means for comparing discharge from one year to the next.*

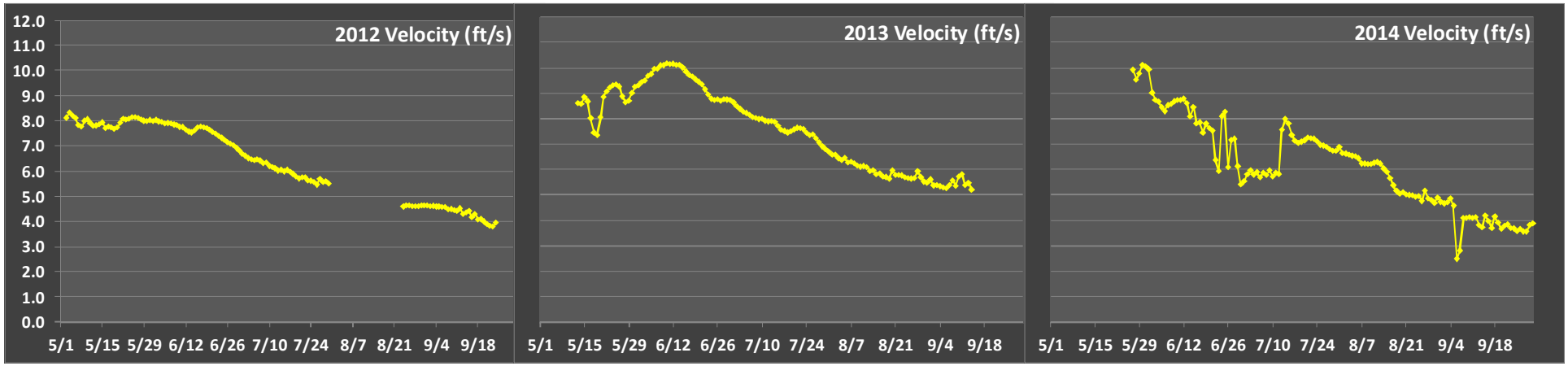
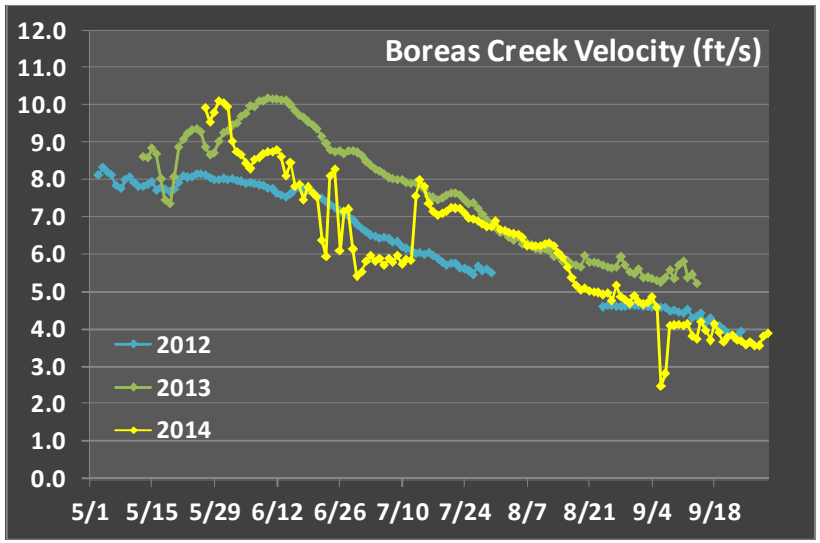
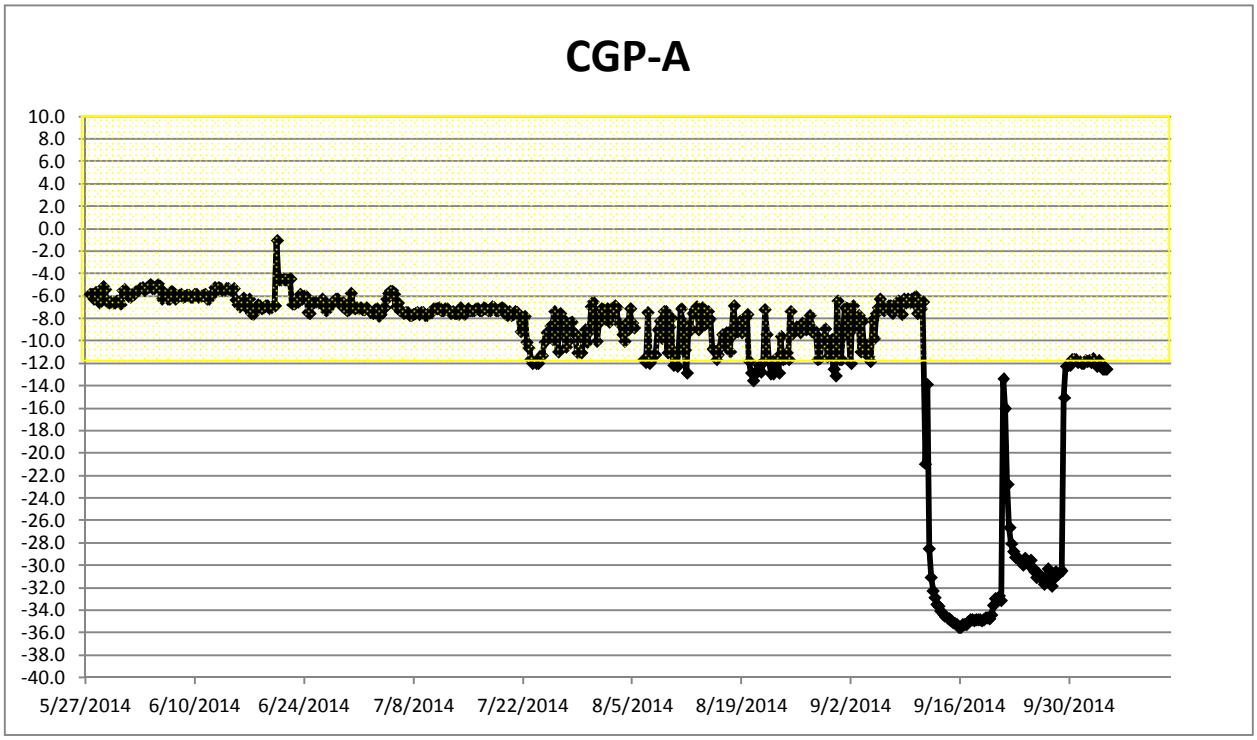


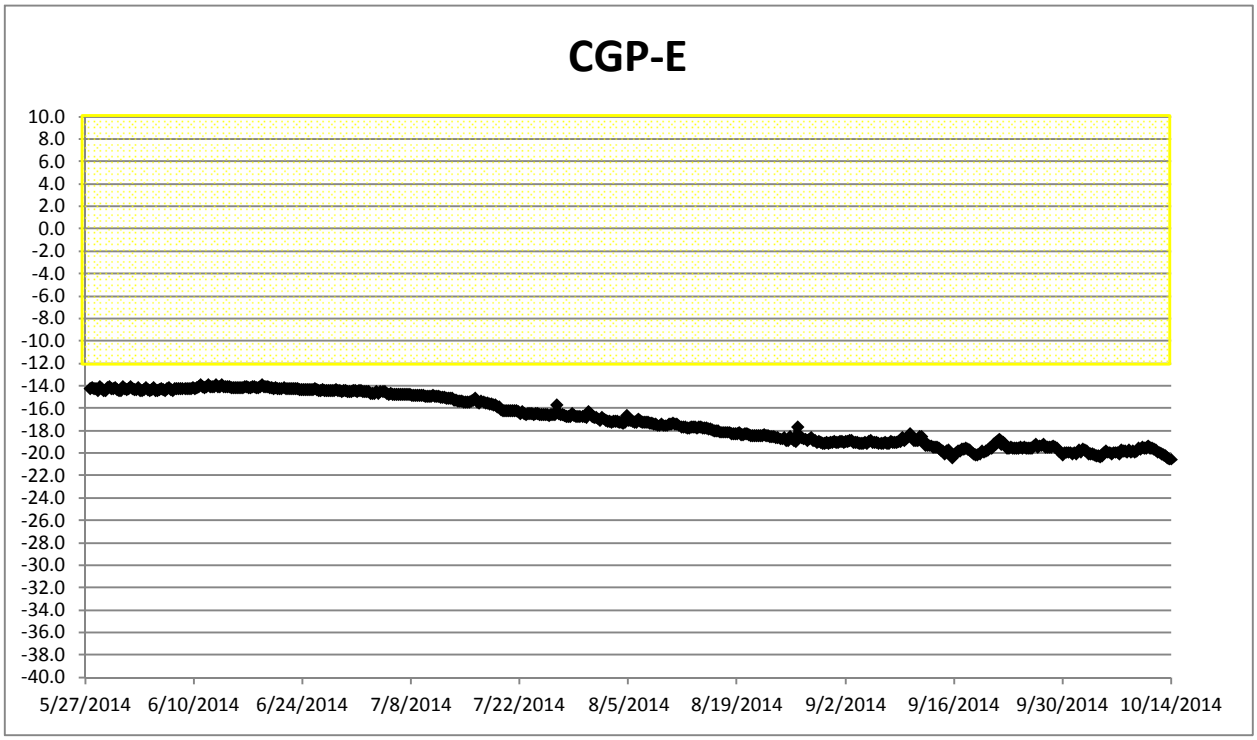
Fig. D2. *Velocity for all three seasons are overlaid for comparison.*

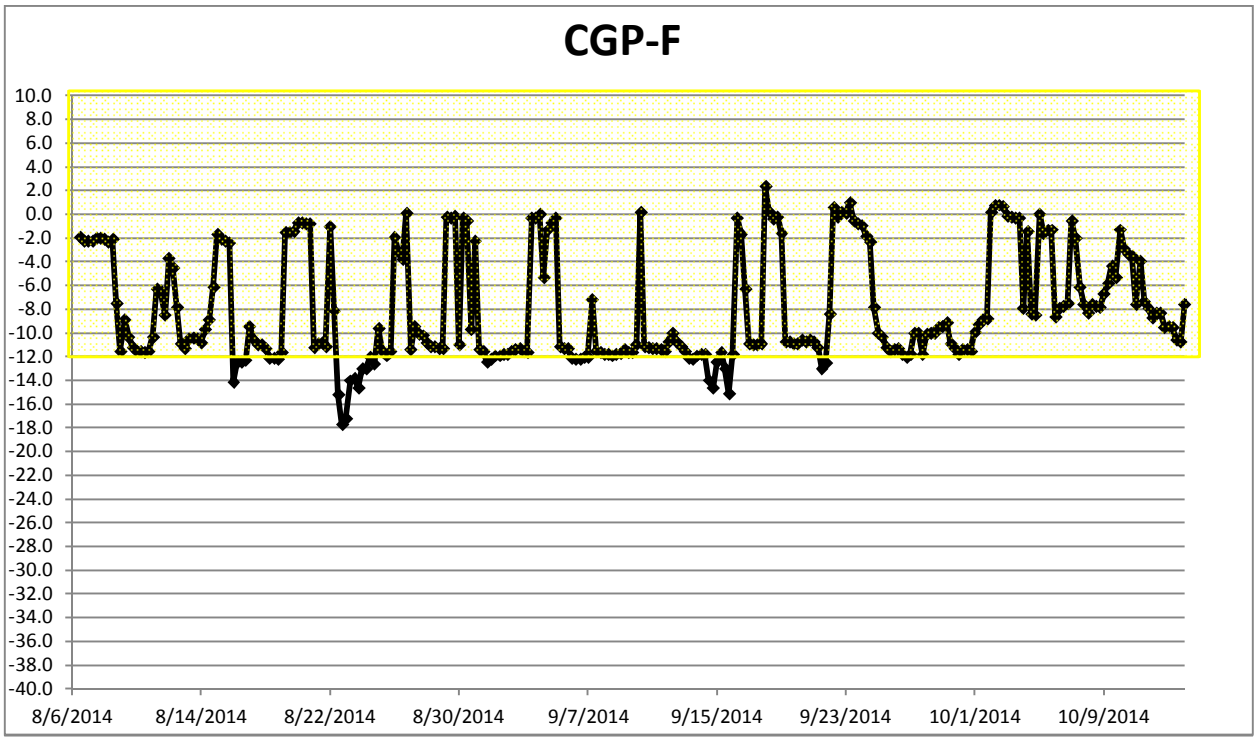


APPENDIX E: HYDROGRAPHS FOR WELLS

Figs. E1 to E8*. The X axis is date. Y axis is depth to the static water table in inches. Yellow shading indicates water table within 12inches of the surface which is a threshold criterion for wetland hydrology.*



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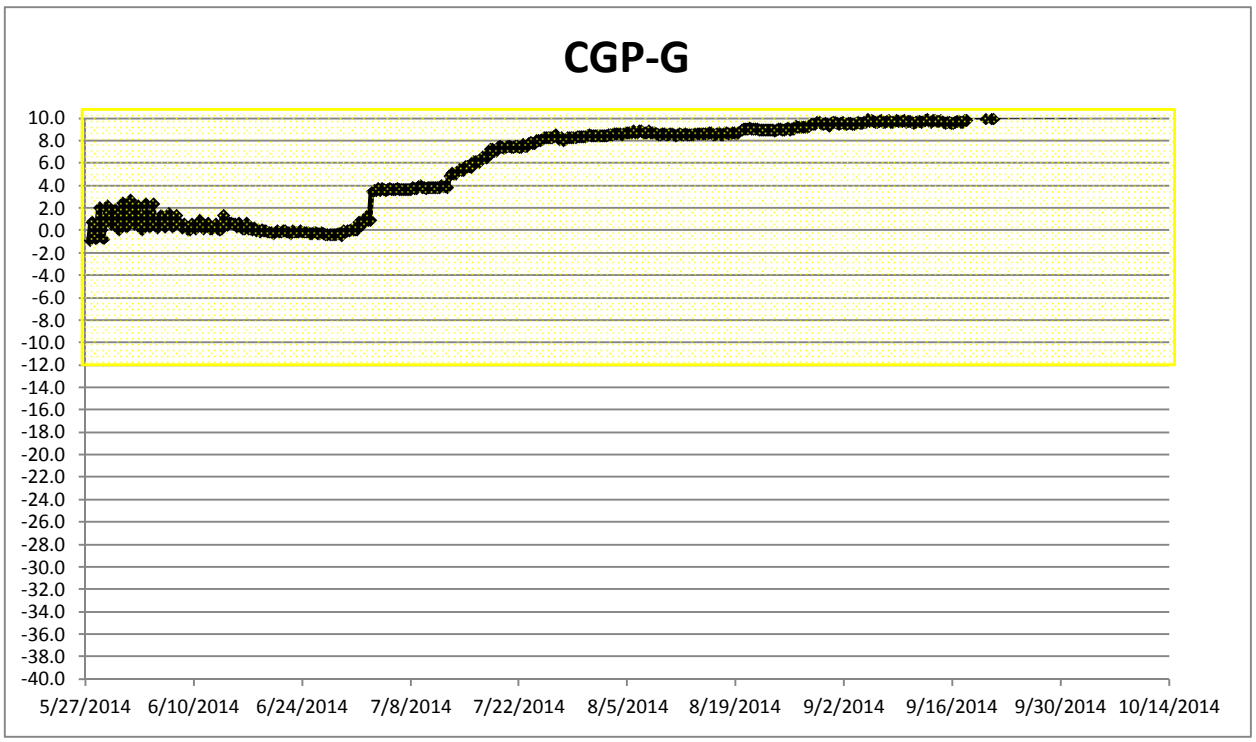
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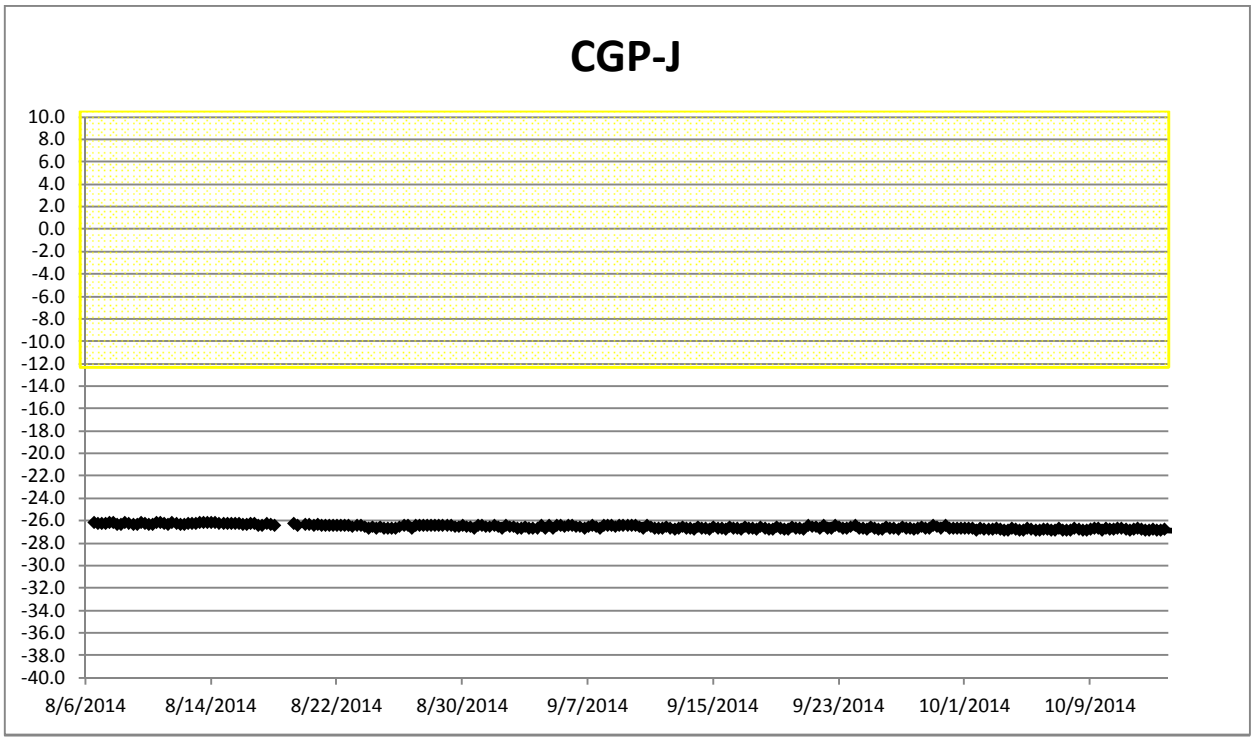
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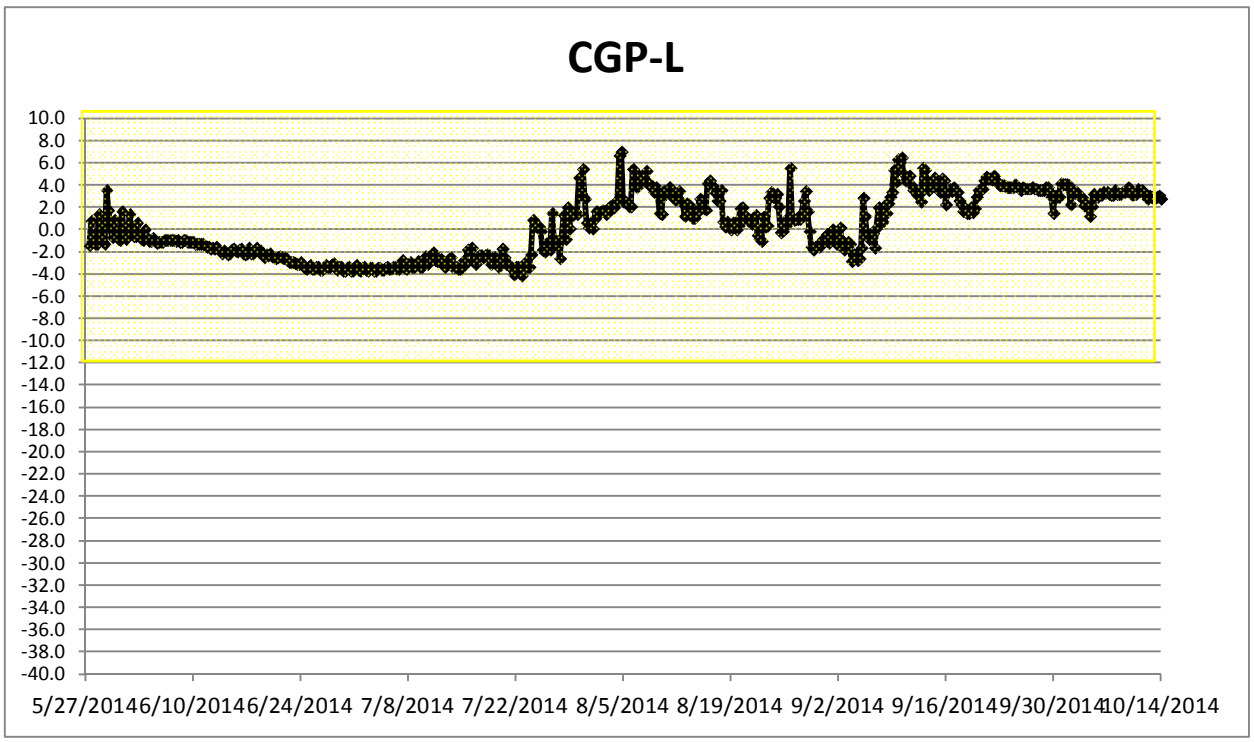
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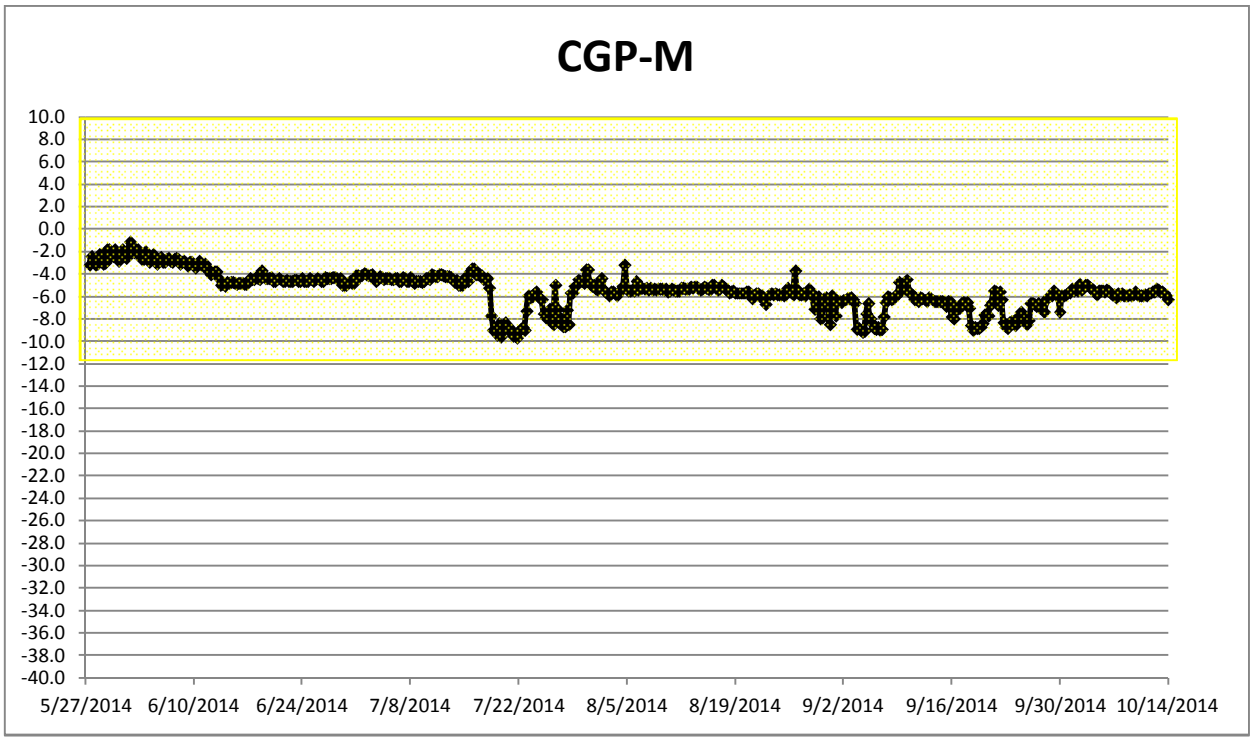
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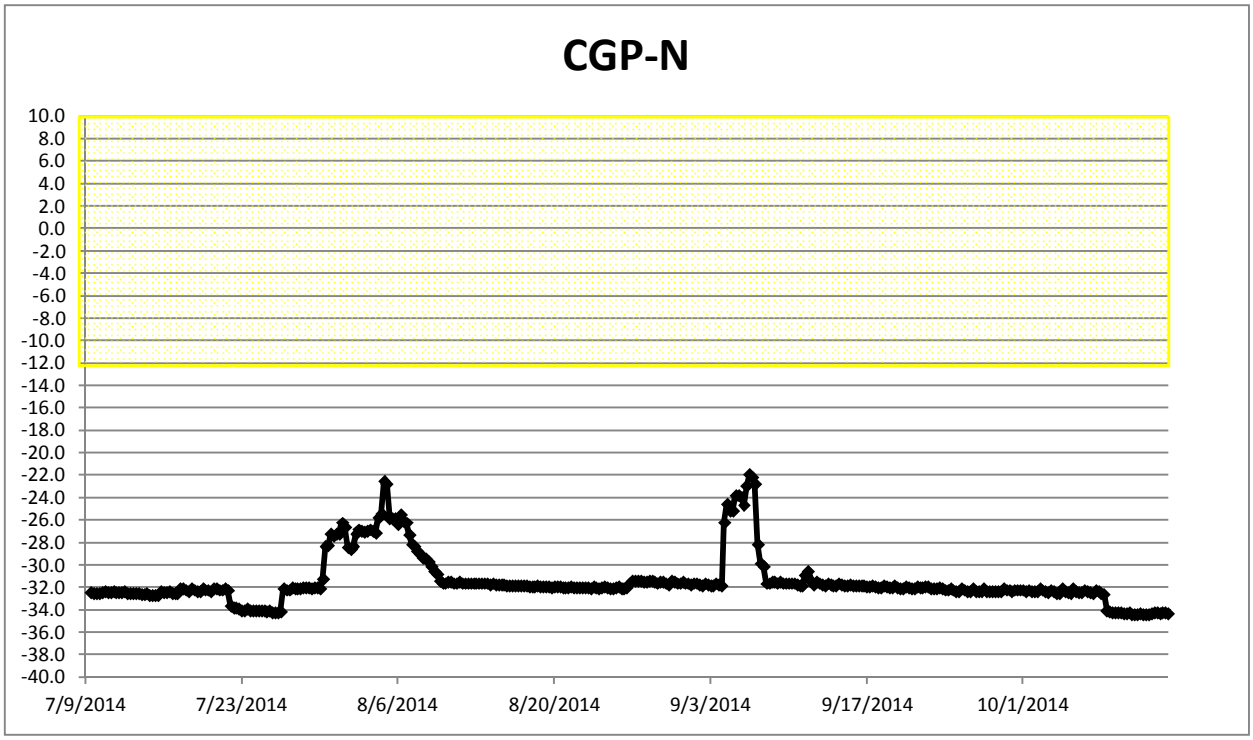
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2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
-16.0
-18.0
-20.0
-22.0
-24.0
-26.0
-28.0
-30.0
-32.0
-34.0
-36.0
-38.0
-40.0
7/9/2014
7/23/2014
8/6/2014
8/20/2014
9/3/2014
9/17/2014
10/1/2014

APPENDIX F: SPREADER POND SURVEYS

Fig. F1*. Topographic map of the spreader pond retention cell. Contours show the difference in bed elevation from May 2013 to September 2014. Most of the sediment deposition is located on a delta that formed at the inlet to the pond (lower left).*

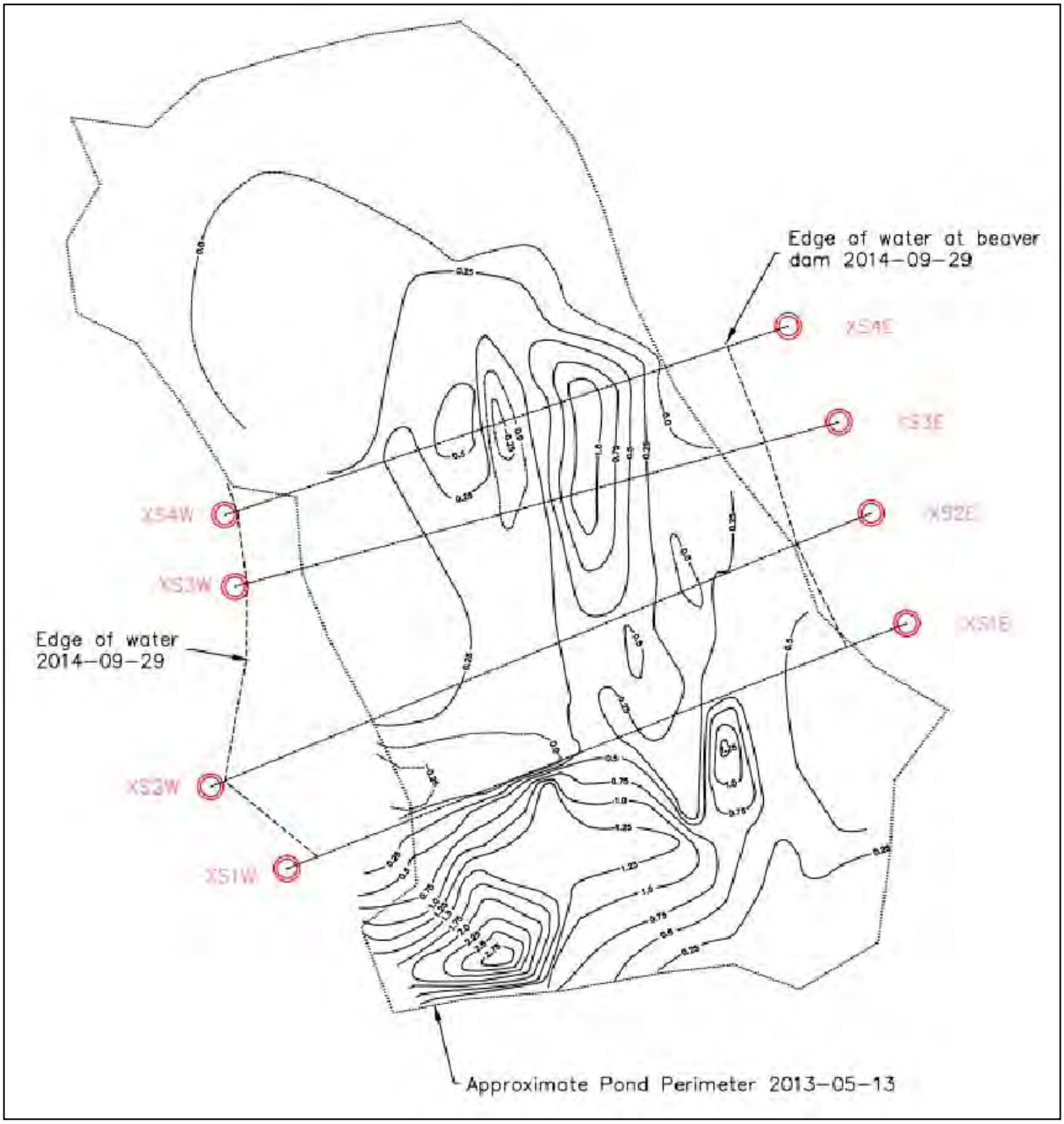


Fig. F2. *XS 1 survey overlays Elevations are relative to a set benchmark.*

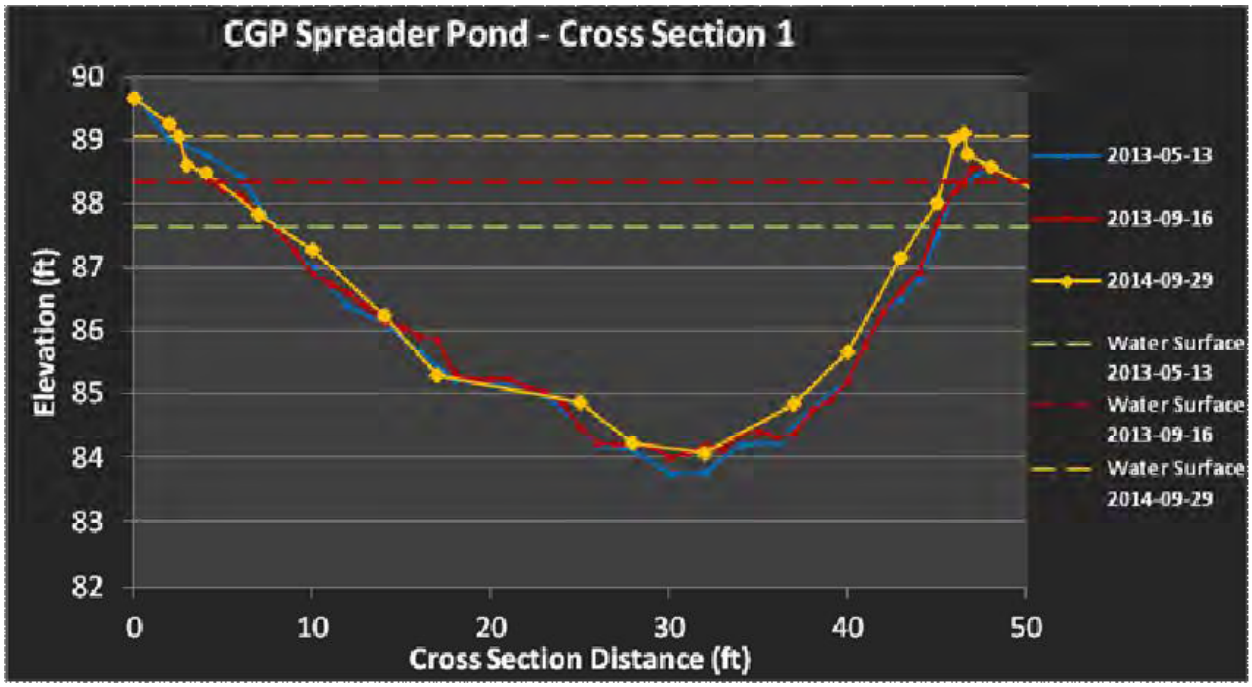


Fig. F3. *XS 2 survey overlays.*

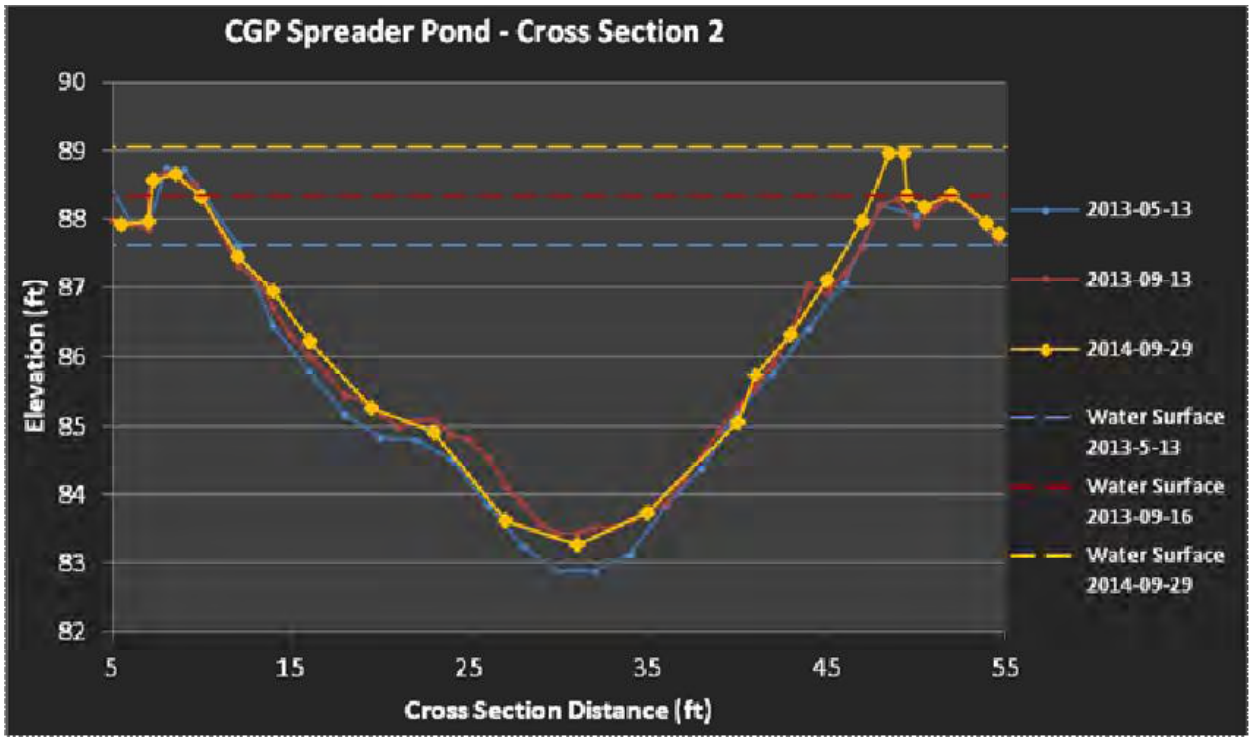


Fig. F4*. XS 3 survey overlays.*

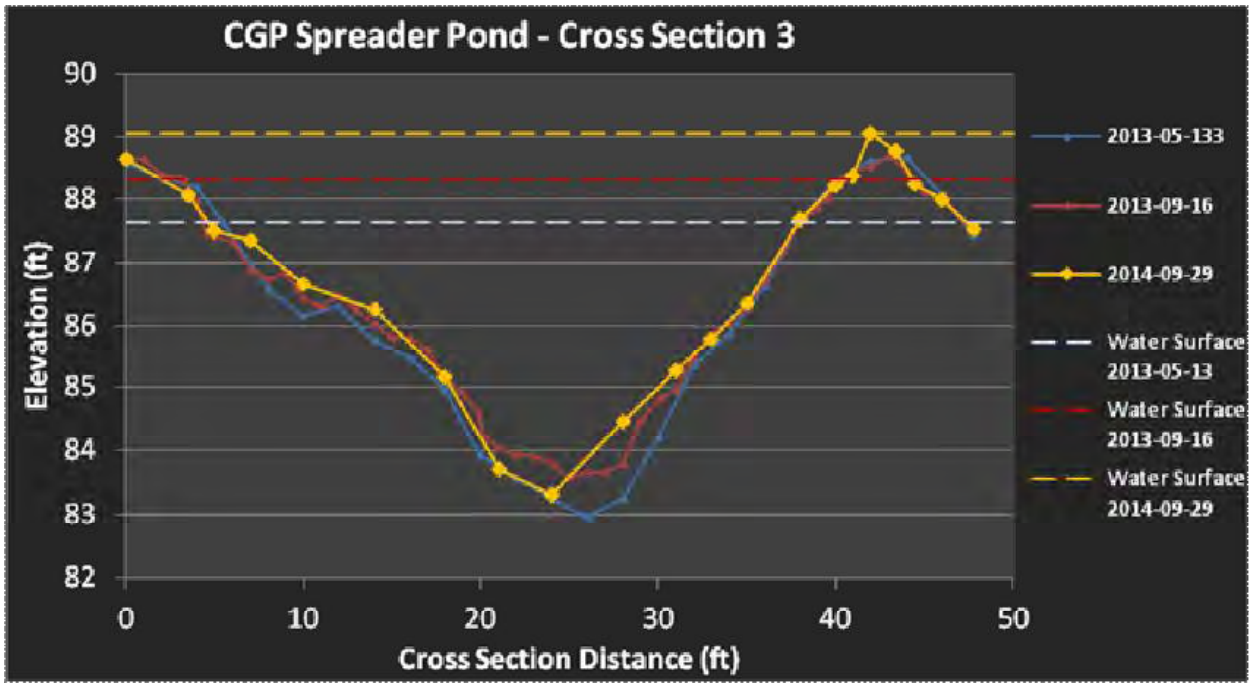


Fig. F5*. XS 4 survey overlays.*

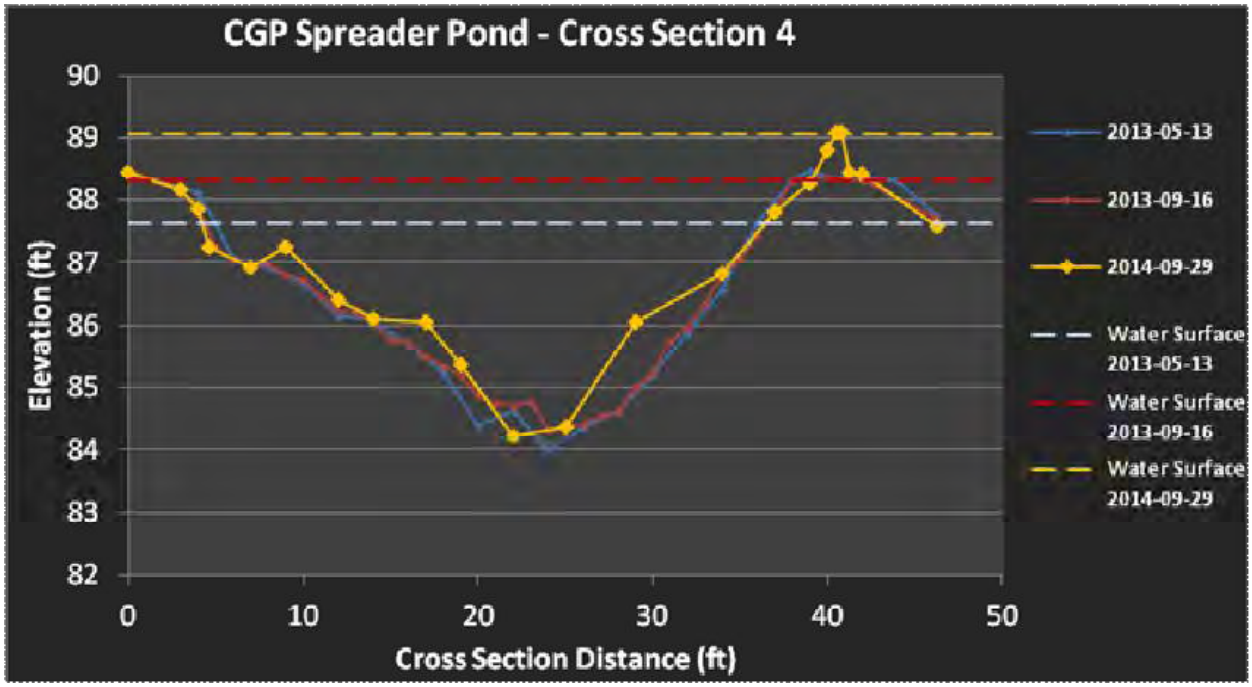
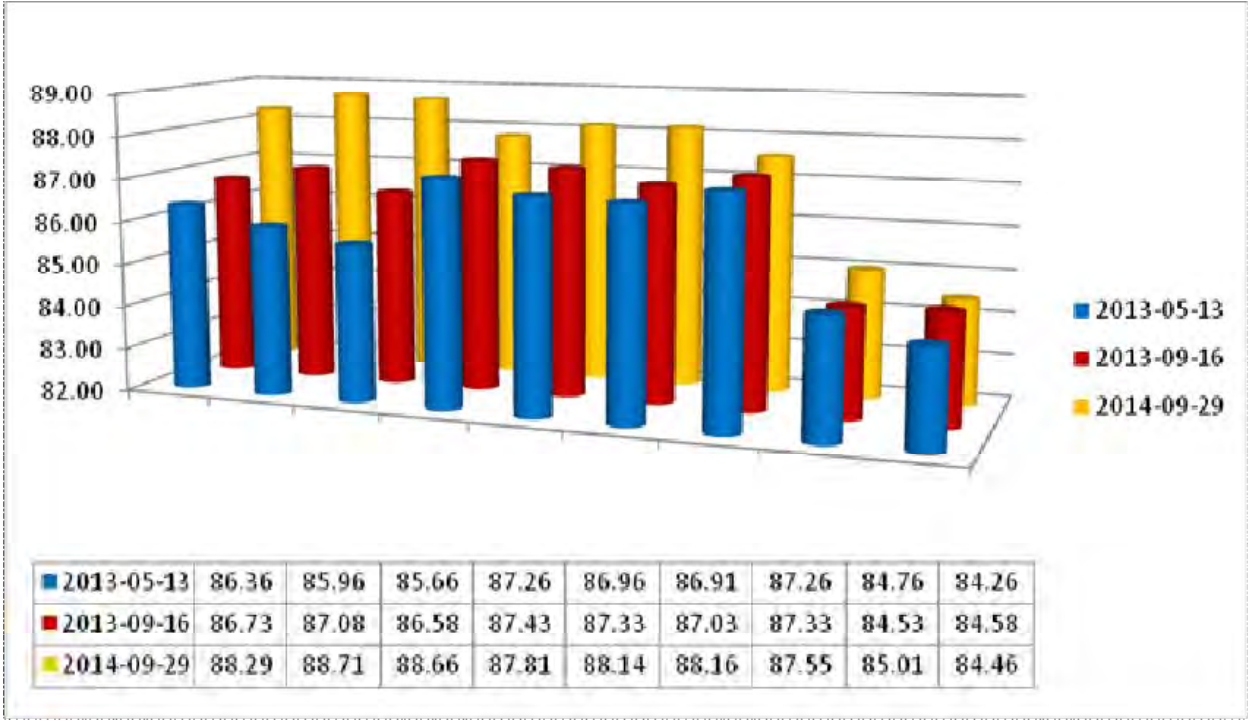


***Fig. F6**. Bed elevation of specific points within the spreader pond.*



2013-05-13	86.36	85.96	85.66	87.26	86.96	86.91	87.26	84.76	84.26
2013-09-16	86.73	87.08	86.58	87.43	87.33	87.03	87.33	84.53	84.58
2014-09-29	88.29	88.71	88.66	87.81	88.14	88.16	87.55	85.01	84.46

APPENDIX G: BOREAS CREEK CHANNEL SURVEYS

Fig. G1. *Longitudinal surveys of the Boreas Creek reach in Upper CG. 2014 data is overlaid upon the 2013 as-built survey.*

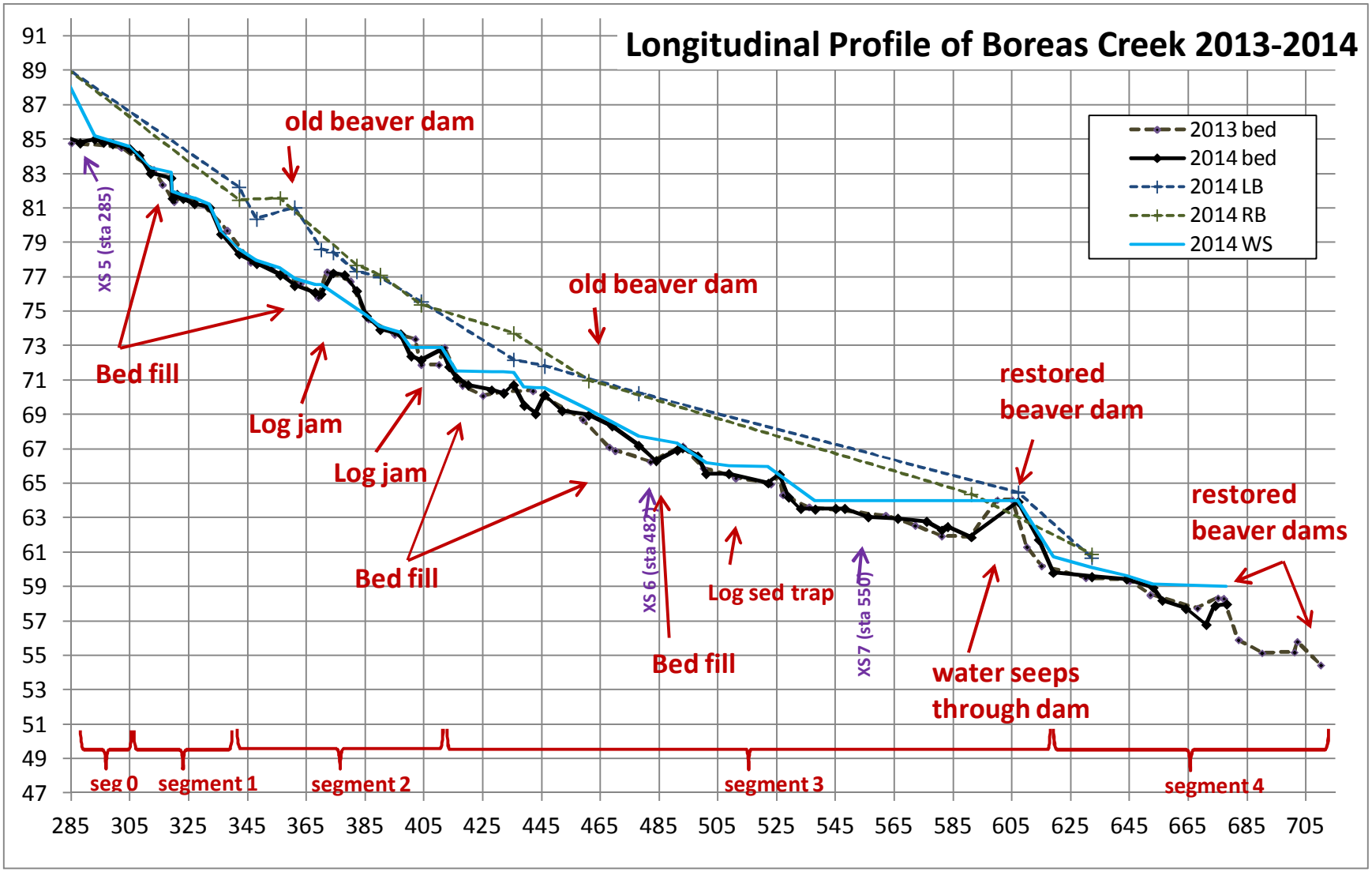


Fig. G2. *XS 5 survey plots for 2012, 2013 and 2014. The channel is aggrading here, with about 0.4 ft of deposition on the right bank.*

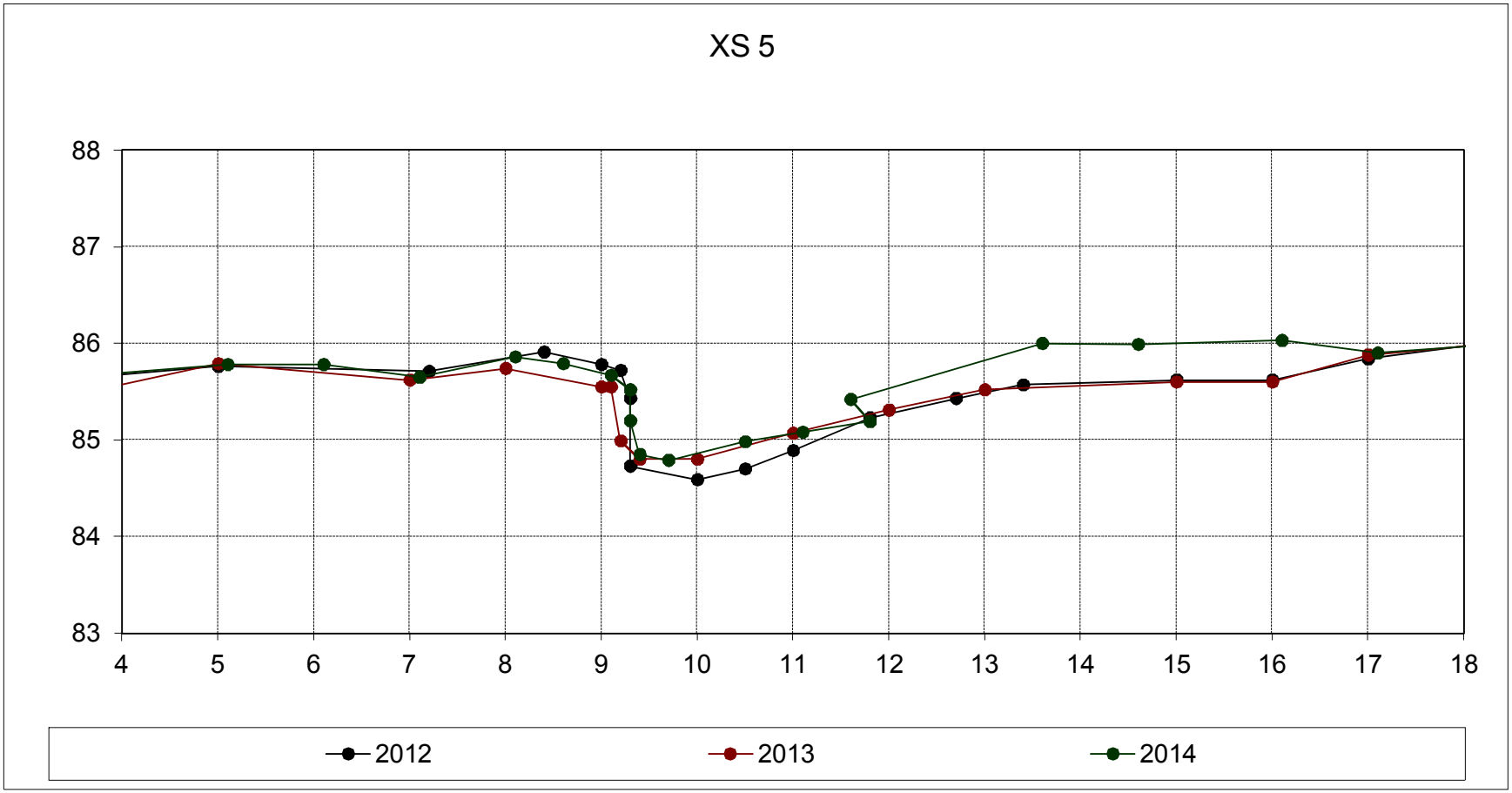


Fig. G3. *XS 6 survey plots for 2012, 2013 and 2014. The major erosion and failure of the cantilevered left bank occurred prior to channel treatments in 2013. Since then, there has been little change.*

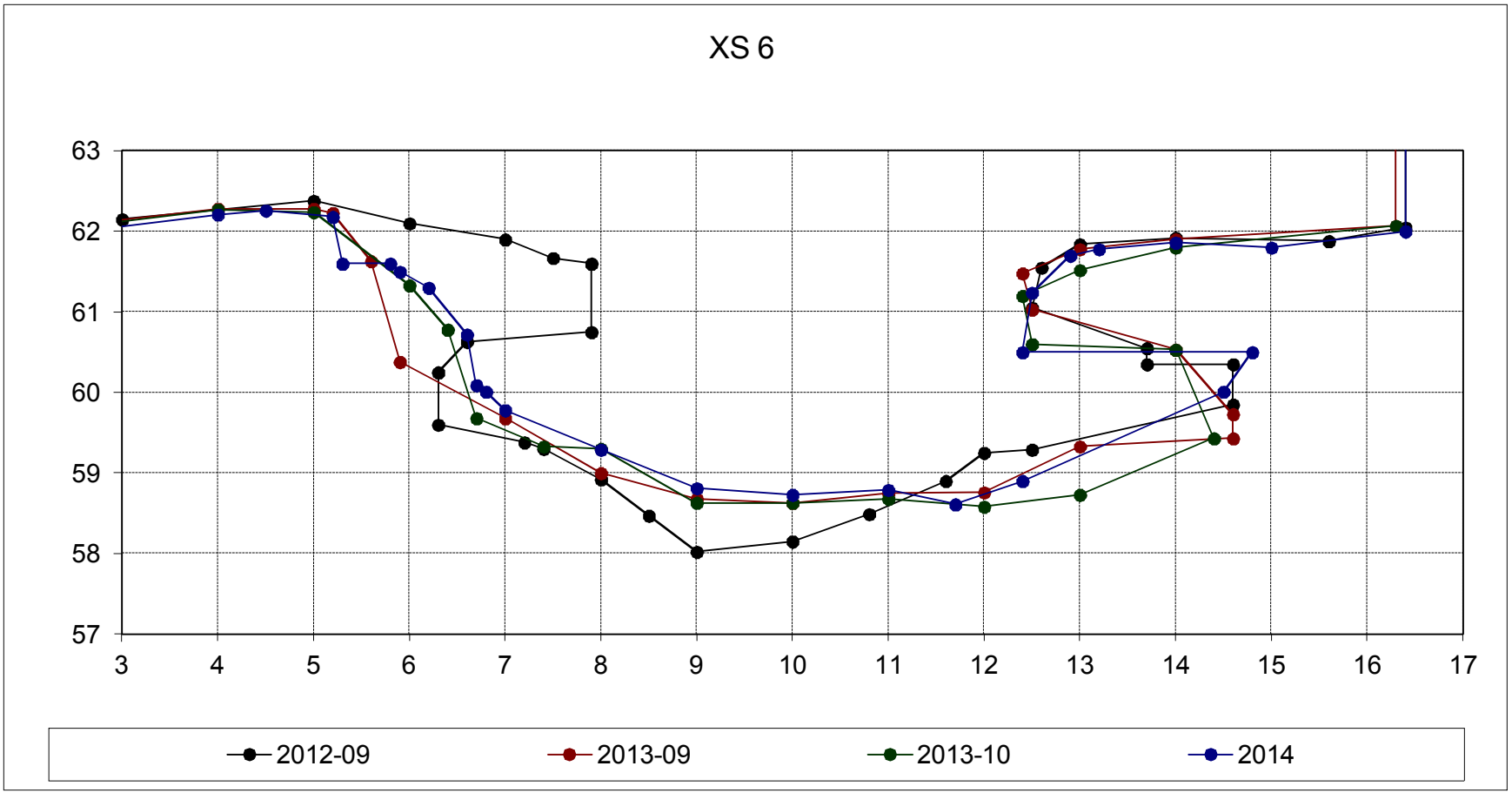
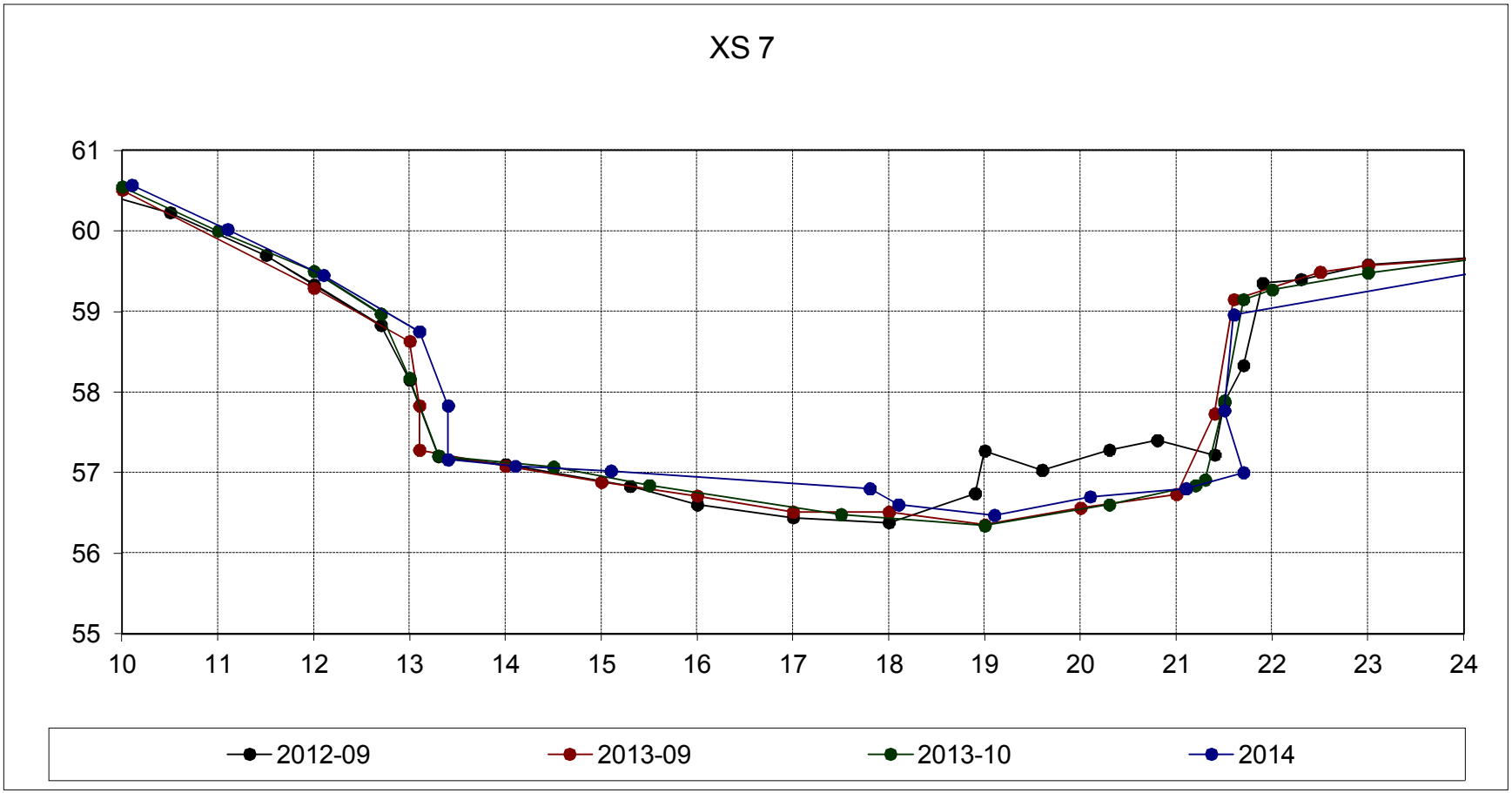


Fig. G4. *XS 7 survey plots for 2012, 2013 and 2014. Like XS 6,XS 7 is between portions of the channel that were mechanically treated, so predictably there is little post-treatment change observed. No significant change in channel dimension has occurred here since treatment.*



APPENDIX H: SOIL REDOX POTENTIAL

Fig. H1. *Redox potential for the for the study sites in the 2014 season in mV. The yellow dotted line at 300 mV represents a threshold for aerobic vs. anaerobic soil conditions. Anaerobic soil typically exhibits redox potential less than 300 mV.*

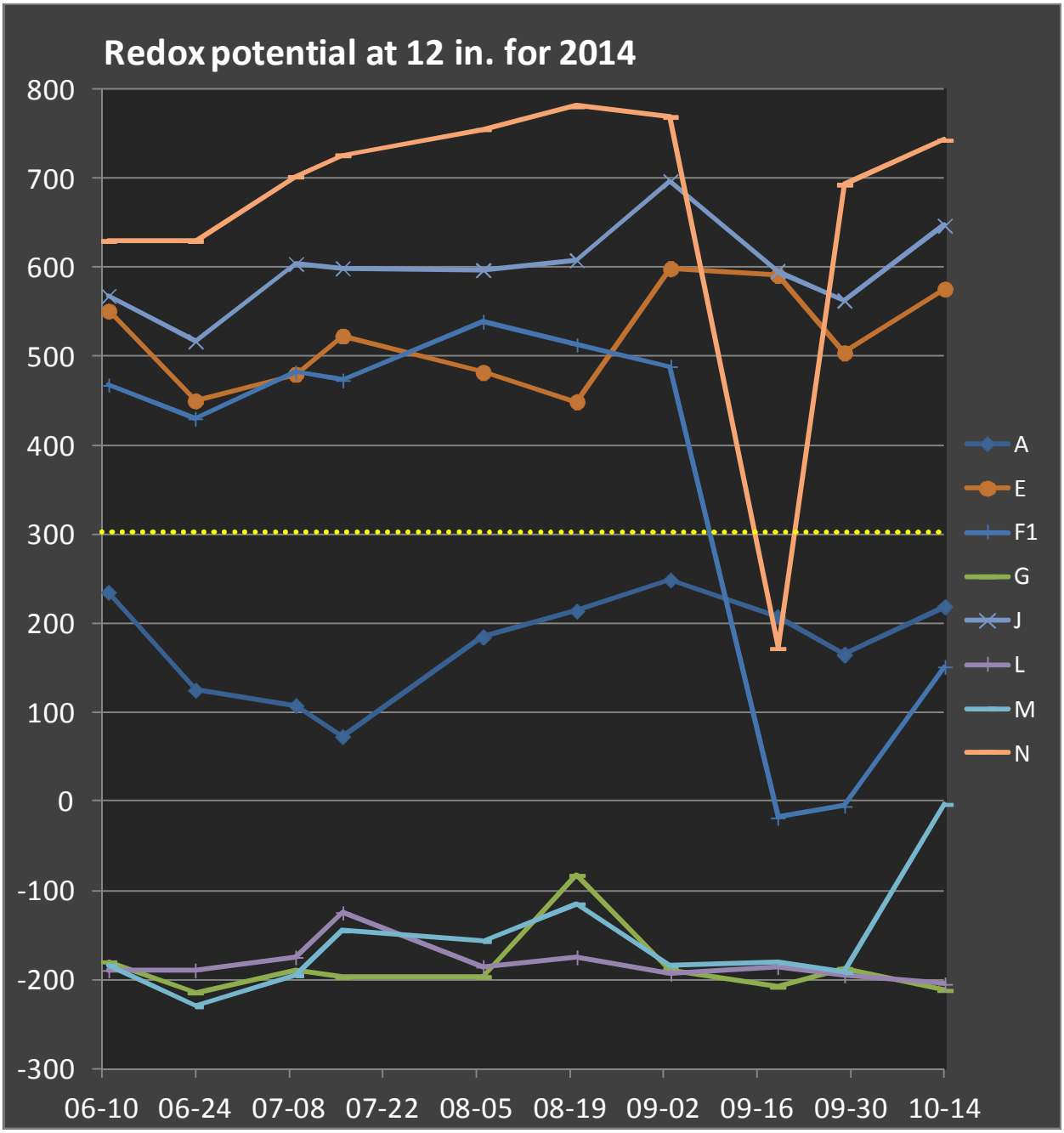
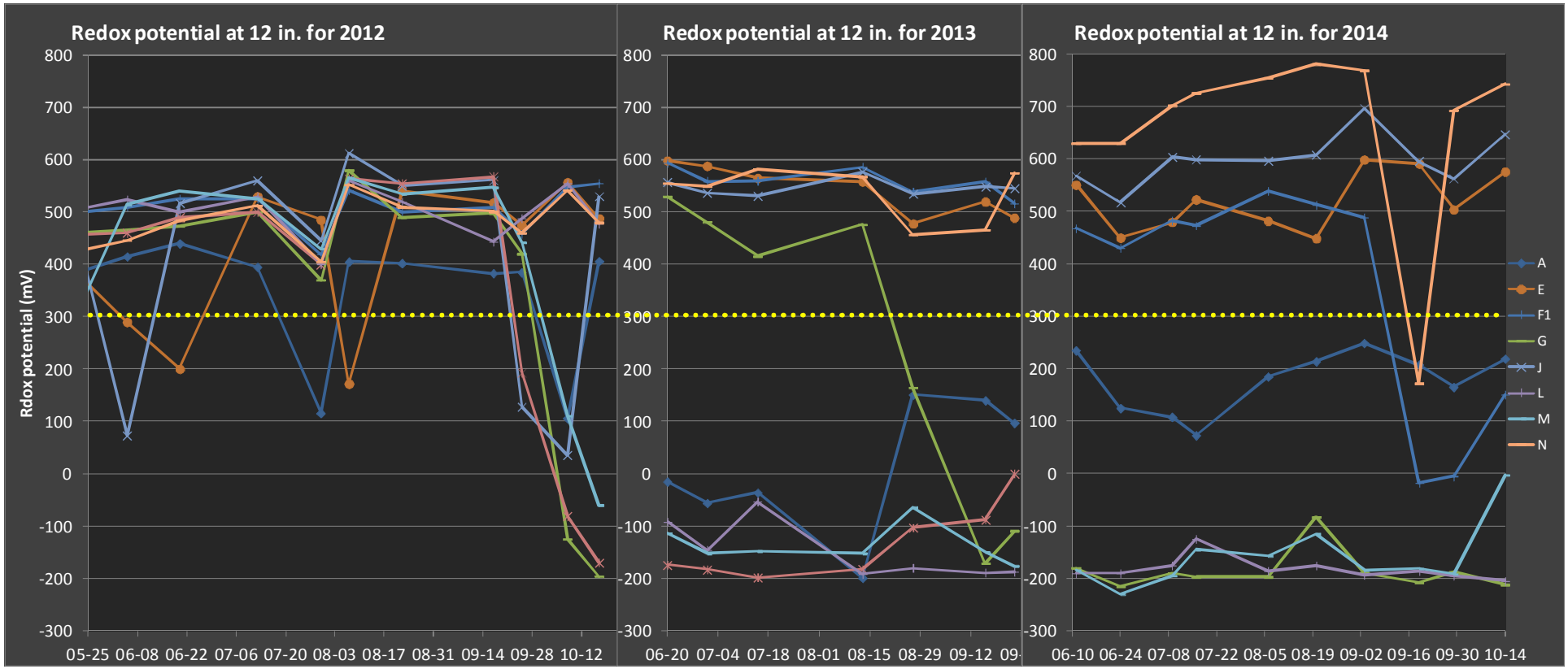


Fig. H2. *Redox potential for the study sites in the 2012, 2013, and 2014 season in mV. The yellow dotted line at 300 mV represents a threshold for aerobic vs. anaerobic soil conditions. Anaerobic soil typically exhibits redox potential less than 300 mV.*



APPENDIX I: VEGETATION DATA

Fig. I1. *Species cover values for study plots at each of the sites in 2014.*

2014 Species list		Wetland Indicator	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Ground	Bare ground		65				5	3				3		0.1		7
Litter	Litter						2					4				10
Water	standing water			100	100				100	100	100		100		65	
ACHMIL	*Achillea millefolium*	FACU														2
ACOCOL	*Aconitum columbianum*	FACW						7						5		
AGRSCA	*Agrostis scabra*	FAC					6					4			3	5
ALOAEQ	*Alopecurus aequalis*	OBL					5	4							2	
ALOALP	*Alopecurus alpinus*	FACW										2				
BROCIL	*Bromus ciliatus*	FAC										3		5		20
CALCAN	*Calamagrostis canadensis*	FACW										20				
CARMIC	*Carex microglochin*	FACW					2									1
CARAQU	*Carex aquatilis*	OBL					20					2				2
CARCAN	*Carex canescens*	OBL													35	
CARUTR	*Carex utriculata*	OBL					10							2	5	0.1
CHAANG	*Chamaenerion angustifolium*	FACU						1				0.1		2		2
CIRARV	*Cirsium arvense*	FAC	0.1					1				3				
CLASPP	*Claytonia spp.*														0.1	
CYMSPP	*Cymopterus spp.*															0.1
DESRIC	*Descurainia incana*	FACU						1				3				
ELYREP	*Elymus repens*	FAC										35				
EPIHOM	Epilobium hornemannii	FACW													0.1	
ERIPER	*Erigeron peregrinus*	FACW														1
EQIARV	Equisetum arvense	FAC					2									
FRASPP	*Fragaria spp.*	FACU														7
GEUMAC	*Geum macrophyllum*	FAC					1									2
HERSPH	*Heracleum sphondylium*	FAC	5				7	4				3		25		
LONINV	*Lonicera involucrata*	FAC						2						4		
MERCIL	*Mertensia ciliata*	FACW	2				2	2				2		3		3
PHAARU	*Phalaris arundinacea*	FACW	30													
PHAANG	*Phalaris angusta*	FACW					1									
POACOM	*Poa compressa*	FACU										5		7		
SALPLA	*Salix planifolia*	OBL	10				35	90				10		70	3	15
SALMON	*Salix monticola*	OBL					4									20
THAALP	*Taraxacum officinale*	FACU					0.1									3
	Umbel androcace														3	
VERSPP	*Veratrum spp.*											1				
VERSPP	*Veronica spp.*	OBL													2	2
	Nodding polygon											2				
	low small matt														7	

TOWN OF
BRECKENRIDGE

DRAFT****DRAFT******DRAFT******DRAFT******DRAFT******DRAFT**

February 24, 2015

Scott Fitzwilliams, Forest Supervisor
c/o Roger Poirier, Project Leader
U.S. Forest Service
120 Midland Avenue, Suite 140
Glenwood Springs, CO 81601

Dear Mr. Fitzwilliams:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the Breckenridge Ski Resort (BSR) multi-season recreation project proposal. The Town of Breckenridge appreciates the opportunity to comment on BSR's proposal. We understand that this is the public comment period for responding to the content of the DEIS and that you will make a final decision based on the public comments received. We also appreciate BSR and USFS staff members attending recent Breckenridge Town Council and BOSAC meetings to better articulate the details of the proposal.

As stated during the initial scoping period letter, the Town of Breckenridge generally supports BSR's goals to expand year-round recreational offerings on the ski area pursuant to the Ski Area Recreational Opportunity Enhancement Act of 2011. The use and expansion of existing on-mountain infrastructure to provide safe, secure nature-based recreational activities for visitors is consistent with the Town's recreational amenity and visitor experience goals. If completed, the proposal would be a significant year-round economic driver for the Breckenridge community.

The Town and BSR have successfully collaborated on many previous projects, including the permanent protection and ongoing management of Cucumber Gulch Preserve. We appreciate BSR's collaborative approach to this and other issues. It is in this partnership spirit that the Breckenridge Town Council offers the following comments to the DEIS:

- In general, the Town supports Alternative 3 as outlined in the DEIS because it is the most balanced approach that accommodates the majority of BSR's project proposal, the USFS's resource protection mandates, and the Town's goals for both resource protection and visitor amenities. The one caveat with the Town's support of Alternative 3 overall pertains to the Peaks Trail connection. This issue is reviewed in detail below.

- Surface drainage from Peak 8 into the existing Boreas Creek inlets and Upper Cucumber Gulch continues to be a shared priority for both the Town and BSR. In fact, the Town and BSR recently worked jointly to restore wetlands in Upper Cucumber Gulch and successfully returned a beaver population to the area. Protection of this precious wetland resource continues to be a mutual goal for the

Town and ski area. BSR has previously acknowledged and acted on its responsibility for enhancing drainage and ski slope revegetation efforts to reduce sediment loads in Cucumber Gulch Preserve via the 60" culvert. The additional infrastructure included in this proposal emphasizes the need to install and appropriately maintain the on-mountain sediment traps to reduce sediment transport into the protected wetlands of Cucumber Gulch. We ask that the USFS thoroughly review the infrastructure installations and best management practices to ensure wetland protection efforts are consistently applied and appropriately maintained.

- The revegetation element of the proposal is also a high priority for both the Town and BSR. Improving native vegetation on the ski area (e.g. ski runs) promotes groundwater infiltration, minimizes runoff volumes and peak flows, reduces sediment transport, and supports joint BSR/Town downstream wetland protection efforts. We support BSR and the USFS articulating and executing native revegetation efforts across the ski area. To be truly effective, any on-mountain revegetation efforts will need to successfully promote native grass and plant growth while not relying heavily on chemical fertilizers and herbicides, both of which affect wetland health and are prohibited in Cucumber Gulch Preserve. Applying fertilizers and herbicides on areas that drain into the 60" culvert could affect water chemistry, vegetative growth, amphibian viability, and overall wetland protection efforts in Cucumber Gulch. We ask that the USFS and BSR cooperatively develop a coherent, benchmarked on-mountain plan to maximize native ground cover revegetation while minimizing the use of fertilizers and herbicides. We recommend that compost be used to encourage the growth of native vegetation (as has been successfully done at Keystone) and that ongoing monitoring ensures that noxious and non-native weeds do not proliferate.

- In 2014, BSR submitted to Town staff a draft base area master plan for the portions of the ski area **not** on National Forest lands. The addition of more on-mountain infrastructure proposed by BSR emphasizes the need for an integrated base area plan that provides clear direction for the future management of crowd control, special event management, and infrastructure needs. We appreciate the USFS and BSR working cooperatively with the Town to ensure that the Town-focused base area plan supports the infrastructure plans located on the National Forest, and vice versa. These two planning efforts should support inter-jurisdictional, cooperative land management. We specifically request that any changes to the base area master plan prompted by this USFS decision are presented to the Town by BSR representatives.

- As has been previously discussed with both BSR and USFS staffs, extending the Peaks Trail through the ski area to bypass Cucumber Gulch and the pedestrian-only Peak 8 base area would improve trail connectivity between Town and this popular USFS trail. As part of the Town Council approval to operate the Breckconnect gondola during summer months, BSR agreed to pursue the NEPA analysis and construction of this singletrack bypass route. This proposed trail alignment is reviewed in the DEIS and the Town strongly supports the Peaks Trail alignment referenced in Alternative 2. This trail alignment would provide a suitable singletrack experience for trail users seeking to connect from popular Peaks Trail to the Town of Breckenridge while bypassing the sensitive Cucumber Gulch Preserve. The Alternative 2 alignment (proposed by BSR) is much preferred to the use of existing ski area service roads outlined in Alternative 3 because the singletrack would help

trail users bypass Cucumber Gulch. Use of existing ski area service roads as outlined in Alternative 3 would not achieve the stated goal of the trail because 1) it would be a significantly different experience than the existing Peaks Trail and would therefore discourage use, and 2) it would climb higher than necessary on the ski area, and therefore discourage use.

In summary, the Peaks Trail alignment proposed in Alternative 2 would realize a longstanding vision of the Town and BSR while the Peaks Trail alignment outlined in Alternative 3 would not achieve the purpose and need for the trail proposal. As acknowledged on page 3-22 of the DEIS, the Alternative 3 Peaks Trail alignment on existing routes would "diminish" the user experience. We believe that the Alternative 3 proposal user experience would be diminished to the extent as to render the trail useless to the target trail user audience. We support the Peaks Trail trail alignment proposed by BSR in Alternative 2.

- Wildlife impacts resulting from the proposed additional infrastructure were thoroughly evaluated in the DEIS. The newly proposed facilities and programming on the ski area outlined in BSR's proposal will inevitably encroach on existing wildlife habitat and could affect wildlife viability. However, the focus of impacts on the core area of the ski resort as outlined in Alternative 3 strikes the appropriate balance between providing a "critical mass" of facilities to accommodate visitors and avoiding areas with limited human impacts. Specifically:

    - We support the removal of the proposed Ore Bucket-based canopy tour and mountain bike trail. The removal of these project elements will decrease human disturbance and activity in a valuable habitat area that currently receives no summer recreational use.
    - We support the removal of the proposed Sawmill zip line and canopy tour which, although exciting visitor amenities, would also prompt significant impacts to wildlife habitat via routine noise in an area that currently experiences few human visitors during summer.
    - We support restricting above-timberline activities to protect alpine wildlife habitat. Specifically, disallowing summer operation of 6-Chair, the Imperial Chair, and above-timberline off highway vehicle tours will help preserve the limited alpine wildlife habitat.
    - We support minimizing tree cover loss to accomplish BSR's infrastructure proposal. Instead, the ski area forests should be managed to maximize the ski area and public benefits, and to promote healthy, wildfire-resistant forests that support wildlife habitat values.
    - To be consistent with Cucumber Gulch Preserve management, we also support seasonal and temporal trail closures to reduce wildlife impacts during sensitive calving or chick-rearing periods.
    - Overall, we continue to support directing summer recreational activities on the already-impacted interior portions of the ski area, rather than the less-impacted periphery and above-timberline areas.

- The visual impacts of the various proposed zip lines, ropes courses, canopy tours, and observation towers were thoroughly analyzed in the DEIS. Alternative 3 appears to strike the appropriate balance between accommodating additional summer and

winter visitation while also avoiding visual impacts of the infrastructure. For example, moving (or completely removing) the observation tower at the base of the Horseshoe Bowl is a logical approach to preventing visual impacts of BSR's proposal. Our goal is to ensure that any new facilities are minimally visually intrusive from Town and the surrounding viewpoints.

- The proposed goal to realign upper Four O'clock Road to make the route more sustainable is commendable, but highly constrained topographically. In general, the Town supports on-mountain travel system improvements that enhance recreational and administrative use, improve hydrologic function, improve vegetative regeneration, and limit sediment transport. We recommend that the USFS and Summit County engineers thoroughly evaluate this realignment proposal with these goals in mind.

- We support the concept in Alternative 3 that restricts above-timberline off highway vehicle tours because those tours would impact the limited and fragile alpine tundra and wildlife habitat areas.

- The Town of Breckenridge generally supports improvements to the existing mountain biking and hiking trail network on the Breckenridge Ski Area. Expansion of the summer trail system, with a goal of providing lift-served access to intermediate flow trails, would significantly improve Breckenridge's broader bike-related offerings. However, we ask the USFS and BSR to creatively design the proposed infrastructure to locate it in the core of the existing facilities and away from currently undeveloped (or lightly developed) peripheral areas and sensitive wetland and wildlife areas. Also, we believe two specific public trail access concerns regarding this proposal warrant further discussion and evaluation:

    1) Ensuring that necessary improvements and upgrades to the *existing* trail network are implemented to make use of and improve existing infrastructure wherever possible, and
    2) Establishing and designating access routes for uphill, non lift-served users.

  Utilizing and improving the existing trail system ensures that maintenance occurs on the existing infrastructure. Designating uphill travel routes ensures that non lift-served users can continue to utilize our National Forest trails safely. This model has worked will in other locations with directional, lift-served trail systems (e.g. Steamboat).

Thank you for the opportunity to comment on this proposal. If you have any questions or concerns regarding this letter, please contact Scott Reid at 970-547-3155 or ScottR@townofbreckenridge.com.

Sincerely,

John Warner, Mayor

MEMORANDUM

TO: Town Council
FROM: Open Space staff
DATE: February 4, 2015 (for February 10th meeting)
SUBJECT: Open Space Pro Forma and County Funding Request for Swan River Restoration

At Town Council's direction, in November and December BOSAC reviewed the open space pro forma with the goal of allocating a potential future surplus in the open space fund. During BOSAC's two lengthy discussions regarding program priorities, they identified four primary focus areas in which additional expenditures should be allocated: pay down of debt associated with the B&B property loan, habitat/river restoration, land acquisitions, and trails construction/Hoosier Pass recpath.

Since BOSAC's recommendations were made, staff has researched how best to edit the pro forma to reflect these priorities. The following is an update on each of the four focus areas:

1. **B&B debt pay down**: The B&B bond debt (current payoff scheduled in 2026) is part of a much larger bundled bond package that includes a number of other municipalities, utilities companies, etc. There is a brief window of opportunity in 2015 to pay off the B&B debt but the open space fund balance is currently not nearly large enough to pay off the debt. BOSAC was interested in potentially paying an additional $200,000 per year to pay down the debt earlier, but penalty fees associated with the bundled bond make that approach impractical. Based on further discussions, the attached pro forma includes a payoff of the bond debt in 2015, with $700,000 from the open space fund and the remainder from a general fund loan. The pro forma shows payback to the general fund over a five year period (by 2020).

2. **Habitat/river restoration**: BOSAC strongly supports open space fund allocations toward river restoration and habitat improvements. Accordingly, staff allocated 30% ($1,290,000) of the McCain/Blue River restoration project costs in the pro forma over the next three years. Based on Summit County's request, BOSAC also recommended committing $300,000 over two years towards the Swan River restoration on joint open space on Tiger Road. Both of these projects would improve river function, riparian habitat, viability of aquatic species (e.g. fish and invertebrates), and recreational access. The habitat/river restoration line item remains at $150,000 per year into the future in anticipation of other future river restoration efforts on both the Blue and Swan Rivers and possibly the French.

3. **Land acquisitions**: Additional dollars were allocated to the miscellaneous land acquisitions line item to increase flexibility for open space purchases. In

years 2016 and 2017, $80,000 was added to the line item and $200,000 in additional funding was added annually thereafter.

4. **Trails construction/Hoosier Pass recpath**: $100,000 in additional funding was added annually to increase trail construction and maintenance productivity, and to establish seed money for the Hoosier Pass recpath project. BOSAC agreed that the Hoosier Pass recpath concept, although ambitious and expensive, should be prioritized to establish an important commuter and recreational pathway between the Towns of Breckenridge and Blue River, and beyond. The proposed seed money was viewed as a way to encourage Summit County and its partners to implement the vision set forth in its Hoosier Pass recpath feasibility study.

Attached for Town Council's review is a revised open space pro forma that includes additional expense line items highlighted in bold to address each of BOSAC's program priorities.

Staff requests Town Council review the attached draft pro forma and answer the following questions.

1. ***Does Town Council agree with BOSAC's program priorities and focus areas?***
2. ***Does Town Council concur with the proposed pro forma allocations and the $300,000 contribution towards the Swan River restoration in particular and the approach to the B&B debt restructure?***
3. ***If not, what edits would Council like to see to the open space pro forma?***

TOWN OF BRECKENRIDGE OPEN SPACE FUND PRO FORMA

	Actual	Budget	Projected	Proposed									
EXPENDITURES	**2013**	**2014**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Comments**
Land Acquisitions	827,450	450,000	557,585	465,000	478,950	493,319	508,118	523,362	539,062	555,234	571,891	589,048	Budget line items 54421 and 53410 $557,585 commited so far in 2014 3% annual growth
Additional Land Acquisitions					**80,000**	**80,000**	**200,000**	**200,000**	**200,000**	**200,000**	**200,000**	**200,000**	**$ proposed to be added to the "Land Acquisitions" line item**
Main St. Property Acqusition (Bartlett & Shock Lots 52 & 53)	200,000	399,996	400,000	350,000									Main St. park parcels acquisition, paid back to Town General Fund that carried initial purchase
Welllington/Oro Treatment Plant	180,945	174,005	174,200	174,000	179,220	184,597	190,134	195,839	201,714	207,765	213,998	220,418	Wellington/Oro treatment plant costs (53400), including part-time operator (15k for 2014 and 2015), and plant replacement fund (11k allocated annually)
Debt Service B&B	297,627	302,402	302,402	150,946									$4.5mil bond @3.5% 20 yrs; based on principal and interest payments scheduled. 2026 payout scheduled. First payment of 2015 of $150,946 has already been made.
B&B Payoff				**709,500**	**426,146**	**426,146**	**426,146**	**426,146**	**426,146**				**2015 Includes $700,000 payment from open space fund, $1,965,000 loan from general fund, and $9,500 in payoff fees to payoff existing bond debt. 2016-2020 includes re-payments to the general fund, with 3% annual interest paid.**
Blue River Restoration/McCain stretch				600,000	210,000	480,000							30% of river restoration costs to be shared with capital fund. Total project cost $4.3 million.
Habitat/River Restoration				**150,000**	**150,000**	**150,000**	**150,000**	**150,000**	**150,000**	**150,000**	**150,000**	**150,000**	**For Swan River and future Blue River restoration projects.**
Blue River Parks/Block 11				25,000	45,000		100,000		100,000		100,000		Phase 1 of river park improvements in 2015/2016, costs shared with capital fund with hopes of $350k grant from GOCO. Future phases (placeholdes included in 2018, 2020, and 2022) would be cost-shared between open space, capital fund, and the housing fund, also with the potential for grants.
Reiling Dredge Preservation/Stabilization				27,500	31,813	47,750							Contribution towards stabilization of Reiling Dredge on Town/County owned open space. Includes three phases outilned in the recently completed Reiling Dredge Preservation Master Plan. All phases are still subject to Town/County approval and determination of what extent of preservation is necessary. Assumes the County and Town share the costs of the preservation 50/50. 50 % of the Town's contribution would come from the BHA capital fund and the remaining 50% would come from the Open space fund.
Administration	263,949	324,336	323,522	359,042	369,813	380,908	392,335	404,105	416,228	428,715	441,576	454,824	51111-51138 (wages and benefits), 52214-53321 (printing and postage), 53372-53374 (training, travel, and BOSAC), 58000 (garage fund) includes 5k for dump truck purchase in 2014, 58020 (facilities fund), 55512 liability insurance, 3% annual growth, 53388-53389 (insurance deductibles), 53338 overages
Legal Services	0	5,004	5,000	5,000	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	53352, Town Attorney time for open space issues, B&B Consent decree followup
Consultants	46,783	79,999	80,000	80,000	82,400	84,872	87,418	90,041	92,742	95,524	98,390	101,342	53355, 3% annual growth, Cucumber monitoring (water quality, wildlife monitoring)
Other professional services/forest mgmt	101,901	102,001	102,000	102,000	105,060	108,212	111,458	114,802	118,246	121,793	125,447	129,211	53359 forest mgmt, weed control, GH forest mgmt/health planning, tree planting, Cucumber Gulch restoration efforts
Other contracted services/surveying	3,200	10,000	8,500	10,000	10,300	10,609	10,927	11,255	11,593	11,941	12,299	12,668	53399 surveying and appraisals
Trails construction and maintenance	145,756	187,500	187,500	217,500	242,500	267,500	292,500	317,500	342,500	367,500	392,500	417,500	52229, 52230, 52231, 54426 Town trails and landscape construction, GH trails, Friends of Breck, $25k annual growth based on increased trail mileage and associated maintenance
Trails/Hoosier Pass Rec Path				**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**Additional allocation towards trails construction and maintenance and/or towards Hoosier Pass Rec Path**
TOTAL EXP	**2,067,611**	**2,035,243**	**2,140,709**	**3,525,488**	**2,516,352**	**2,819,216**	**2,574,501**	**2,538,676**	**2,704,027**	**2,244,443**	**2,412,251**	**2,381,343**	
REVENUES													
Sales Tax	1,985,224	1,961,385	2,320,279	2,363,400	2,387,034	2,410,904	2,435,013	2,459,364	2,483,957	2,508,797	2,533,885	2,559,224	Based on 1% annual growth
Interest	5,343	4,600	9,099	9,490	5,660	3,601	4,668	3,980	4,977	5,611	8,011	12,175	
B&B Land Sales												425,000	Potential divestiture properties (Peabody and Williams Placers--revenues split with County)
TDR Sales	12,610	133,562	9,871	139,675	357,090	10,000	10,100	10,201	10,303	10,406	10,510	10,615	2015 includes: $129,875 for Town's share of TDR proceeds from Peak 8 development and $9,800 for Beaver Run TDR. 2016 includes 18.3 TDRs for Breck Mountain Lodge ($357,090 for Town's share assuming most (75%) are purchased from TDR Bank). 1 % annual growth
Grants	12,275	40,450	30,411	82,500	83,325	84,158	85,000	85,850	86,708	87,575	88,451	89,336	2014 includes $30.4k for SideDoor state trails grant. 2015 includes $52.5k for DNR forest mgmt grant (Town share) and $30k for first installment on state trails grant (Turks, etc., Town's share)
Summit County reimbursement	74,621	82,000	82,000	82,000	84,460	86,994	89,604	92,292	95,060	97,912	100,850	103,875	Wellington/Oro treatment plant costs, not including replacement fund
Trails map sales	4,568	7,000	7,761	7,000	7,070	7,141	7,212	7,284	7,357	7,431	7,505	7,580	1 % annual growth
Miscellaneous	30,286	10,575	35,756	10,600	10,706	10,813	10,921	11,030	11,141	11,252	11,365	11,478	49999 Rental income (dogsled rides) and 44240 W/O zinc sales 1 % annual growth
TOTAL REV	**2,124,927**	**2,239,572**	**2,495,177**	**2,694,665**	**2,935,345**	**2,613,611**	**2,642,518**	**2,670,001**	**2,699,504**	**2,728,984**	**2,760,576**	**3,219,283**	
BEG. BALANCE	**569,650**	**626,966**	**626,966**	**981,434**	**150,611**	**569,605**	**364,000**	**432,018**	**563,342**	**558,818**	**1,043,360**	**1,391,685**	previous year's balance
END BALANCE	**626,966**	**831,261**	**981,434**	**150,611**	**569,605**	**364,000**	**432,018**	**563,342**	**558,818**	**1,043,360**	**1,391,685**	**2,229,625**	
W/O Plant Replacement Reserve	22,000	33,000	33,000	44,000	55,000	66,000	77,000	88,000	99,000	110,000	121,000	132,000	Annual allocation of $11k for replacement of pumps and other equipment at W/O Plant
TOTAL FUND BALANCE	648,966	864,261	1,014,434	194,611	624,605	430,000	509,018	651,342	657,818	1,153,360	1,512,685	2,361,625	

Open Space - Fund Pro Forma

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Beg Fund Bal	$ 569,650	$ 626,967	$ 981,435	$ 150,612	$ 569,606	$ 364,001	$ 432,019	$ 563,343	$ 558,819	$ 1,043,361
Revenue										
Sales Tax	1,985,224	2,320,279	2,363,400	2,387,034	2,410,904	2,435,013	2,459,364	2,483,957	2,508,797	2,533,885
TDR Sales	12,610	9,871	139,675	357,090	10,000	10,100	10,201	10,303	10,406	10,510
Wellington Oro/ County	74,621	82,000	82,000	84,460	86,994	89,604	92,292	95,060	97,912	100,850
Other	52,472	83,027	109,590	106,761	105,713	107,801	108,145	110,183	111,869	115,332
Total Revenue	$ 2,124,927	$ 2,495,177	$ 2,694,665	$ 2,935,345	$ 2,613,611	$ 2,642,518	$ 2,670,001	$ 2,699,504	$ 2,728,984	$ 2,760,576
Available	$ 2,694,577	$ 3,122,144	$ 3,676,100	$ 3,085,958	$ 3,183,217	$ 3,006,519	$ 3,102,019	$ 3,262,847	$ 3,287,803	$ 3,803,937
Expenses										
Acquisitions	1,027,450	957,585	815,000	558,950	573,319	708,118	723,362	739,062	755,234	771,891
Debt Service	297,627	302,402	860,446	426,146	426,146	426,146	426,146	426,146	-	-
Wellington Oro Plant	180,945	174,200	174,000	179,220	184,597	190,134	195,839	201,714	207,765	213,998
Habitat/River Restoration	-	-	750,000	360,000	630,000	150,000	150,000	150,000	150,000	150,000
Blue River Parks/Block 11	-	-	25,000	45,000	-	100,000	-	100,000	-	100,000
Reiling Dredge Preservation			27,500	31,813	47,750					
Trail Constr.	145,756	187,500	317,500	342,500	367,500	392,500	417,500	442,500	467,500	492,500
Admin/Other	415,833	519,022	556,042	572,723	589,905	607,602	625,830	644,605	663,943	683,862
Total Expenses	2,067,611	2,140,709	3,525,488	2,516,352	2,819,216	2,574,501	2,538,676	2,704,027	2,244,443	2,412,251
Total Exp	$ 2,067,611	$ 2,140,709	$ 3,525,488	$ 2,516,352	$ 2,819,216	$ 2,574,501	$ 2,538,676	$ 2,704,027	$ 2,244,443	$ 2,412,251
Inc./(Dec)	57,316	354,468	(830,823)	418,993	(205,605)	68,017	131,324	(4,524)	484,541	348,325
Fund Balance	626,967	981,435	150,612	569,606	364,001	432,019	563,343	558,819	1,043,361	1,391,686
Wellington Oro reserve	22,000	33,000	44,000	55,000	66,000	77,000	88,000	99,000	110,000	121,000
Net Fund Balance	$ 648,967	$ 1,014,435	$ 194,612	$ 624,606	$ 430,001	$ 509,019	$ 651,343	$ 657,819	$ 1,153,361	$ 1,512,686

NOTES:

Revenues - TDR sales include revenues from Peak 8, Beaver Run, Breck Mtn. Lodge, and Maggie Point.
Expenses - Blue River expenses will be shared with Capital and Housing Funds. Wellington Oro plant costs shared with the County.